Performance Analysis of the Greek Banking Sector before and throughout the recent Financial Crisis

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I hereby declare that the work submitted is mine and that where I have made use of another's work, I have attributed the source(s) according to the Regulations set in the Student's Handbook.

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Abstract

This dissertation was written as part of the Executive MBA at the International Hellenic University.

This research paper constitutes an empirical analysis of the performance of the Greek banking sector over the period 2002-2015. Having highlighted the complex and tough environment within Greek banks operate, the trajectory over the fourteen-year period of carefully selected financial ratios related to bank performance is presented. In the next part, the entire period is divided into two equal subperiods; the pre-crisis period (2002-2008) and the period during crisis (2009-2015). Building on a new perspective for analyzing the effect of structural changes on bank performance, it is proved, through the multiple regression analysis, that the external forces, such as Gross Domestic Product, do not constitute significant influencing bank profitability determinants. On the other side, the results related to factors internal to the banking institutions are not so uniform. However, the Equity to Total Assets ratio is proved to significantly affect profitability and to retain this attribute throughout crisis.

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Keywords: Greece, financial crisis, bank performance

Konstantina Ntaliani

30/1/2017

Preface

There are two reasons behind the writing of the present research paper. The first reason relates to the structural changes that the Greek banking system witnessed over the last fifteen years since the inception of the Euro currency. Increased competition, expanded range of the services and products offered, investments in technology, streamlined procedures for administration and risk management, mergers and acquisitions as well vigorous internationalization activity are the main developments that transformed the Greek banking sector and therefore merit discussion. But the most challenging period began in 2008 when the recent financial crisis erupted. The Greek banking institutions suffered major blows in their levels of profitability, battled with the severe consequences of the Private Sector Involvement programme, witnessed a sharp upturn of Non-Performing Loans and struggled with record outflows of bank deposits. The unprecedented severity of these adverse developments and of their repercussions makes the analysis intriguing and leads to the second reason for writing this research paper. Therefore, the performance of the Greek banking sector before and throughout the recent financial crisis and possible alterations in the effect of bank profitability determinants amid the crisis are discussed while possible policy implications complete the analysis.

Contents

List of Abbreviations

ASE ..... Athens Stock Exchange

BoG ..... Bank of Greece

BCBS ..... Basel Committee on Banking Supervision

CAR ..... Capital Adequacy Ratio

CET1 ..... Common Equity Tier 1

CIR ..... Cost to Income Ratio

EBA ..... European Banking Authority

ECB ..... European Central Bank

ELA ..... Emergency Liquidity Assistance

EQTAR ..... Equity to Total Assets Ratio

EU ..... European Union

Eurobank ..... Eurobank Ergasias S.A.

GDP ..... Gross Domestic Product

GDPGROWTH ..... GDP growth

HBA ..... Hellenic Bank Association

HFSF ..... Hellenic Financial Stability Fund

IMF ..... International Monetary Fund

INFL ..... Inflation

LCR ..... Liquidity Coverage Ratio

LDR ..... Loans to Deposits Ratio

LLPGLR ..... Loan Loss Provisions to Gross Loans Ratio

M&As ..... Mergers and Acquisitions

MFIs ..... Monetary Financial Institutions

NBG ..... National Bank of Greece S.A.

NIM ..... Net Interest Margin

NPLs ..... Non-Performing Loans

PSI ..... Private Sector Involvement

RWA ..... Risk-Weighted Assets

ROA ..... Return on Assets

ROAA ..... Return on Average Assets

ROAE ..... Return on Average Equity

ROE ..... Return on Equity

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1. Introduction

The analysis of bank performance is of ultimate importance in both the macroeconomic as well as the microeconomic perspective. In respect of the macroeconomic point of view, the performance of the banking sector significantly affects the stability of the financial market as a whole. Additionally, an enhancement in bank performance is strongly associated with a more efficient apportionment of financial resources and a rise in investments in favor of economic growth and prosperity (Delis et al., 2009). In the microeconomic point of view, taking into consideration the strengthening of competition and the recent developments in the institutional and regulatory framework, the gravity of the issue of bank performance analysis is clearly demonstrated. Also, focusing on Greece, the banking institutions are the most pivotal constituents of the Greek economy with significant and direct contribution to gross national income as well as to the overall development of the Greek economy. However, the recent financial crisis, which provoked radical and severe transformations in the banking sector worldwide, exposed imperfections in traditional performance indicators used by the financial community and encouraged the reconsideration of some of them (ECB, 2010). Moreover, according to Kosmidou and Zopounidis (2008), there are serious difficulties and complexities in gauging bank performance because the products and services they offer are not of tangible nature. Therefore, within the current vulnerable financial environment worldwide, the need for continuous and systematic examination of bank performance is imperative. Besides, the analysis and evaluation of bank performance could serve as a proxy for the analysis and evaluation of performance of the economy as a whole.

This research paper aims (i) to examine empirically the financial performance of the Greek banking institutions (Alpha Bank, Eurobank Ergasias (Eurobank), National Bank of Greece (NBG) and Piraeus Bank) over the period 2002-2015, (ii) to evaluate statistically significant relations between bank performance and the selected financial indicators and (iii) to provide evidence regarding the financial indicators-bank performance nexus identifying alterations in the bank performance interpretation measures under the scope of the recent financial crisis.

Therefore, this study examines the time between 2002 and 2015 during which the most radical and rapid political, economic and social transformations occurred, resulting in a dramatic and unprecedented change in the business and banking map of Greece. To the best of our knowledge, there is no previous published paper covering such a wide time span, from 2002 to 2015, and including the most recent data. Additionally, this study contributes to the investigation of the conventional dynamics of bank performance which are within the scope of interest of academics, bank and market analysts, bank supervisors, rating agencies and investors and which may have been altered due to the incessantly changing environment within Greek banks operate and due to the financial distortions that arose during the sovereign debt crisis period. Furthermore, taking into consideration that this study focuses on the four systemic forces of the Greek banking industry, the value of this study is amplified. The contribution of this study to the management of the banking institutions lies in its considerable potential to serve as a tool for investigating the determinants of bank performance and focusing on those that contribute to its enhancement, for evaluating the predictability of financial analysis tools during periods of financial distress and for formulating optimal policy recommendations. The empirical results of this study suggest that, among the internal determinants of bank profitability, the Equity to Total Assets Ratio (EQTAR) and the Loans to Deposits Ratio (LDR) significantly influence bank profitability over the period before crisis (2002-2008). However, only EQTAR retain this attribute amid the crisis while a new significant bank profitability determinant emerges, the Loan Loss Provisions to Gross Loans Ratio (LLPGLR). It is noteworthy that the external determinants do not constitute significant bank profitability determinants throughout the whole period under examination.

The rest of this paper is organized as follows: The next section provides a background description of the Greek banking sector over the period 2002-2015. Section 3 provides a review of the relevant academic literature on bank performance focusing on the Greek banking system. Section 4 presents the dataset and explains the empirical methodology followed. Section 5 presents and analyses the empirical results, while the last section summarizes the main findings and concludes the paper by including policy recommendations based on the results derived and by offering suggestions for future research.

2. Background

An overview of the recent developments in the Greek banking sector during the period 2002-2015 and of its key features, accompanied by a brief overview of the macroeconomic framework within Greek banks operate, follows.

2.1 Greek Banking Sector Overview

The procedure towards the European monetary unification implied structural changes in the macroeconomic environment of Greece and in the structure of the Greek banking sector, reformed the functioning of money and capital markets and enhanced their efficiency, intensified demand for financial intermediation and, consequently, increased competition among financial intermediaries (Gortsos, 2002). To respond to these challenges, the Greek banks adapted their distribution networks to the new internationally acceptable standards, proceeded with investments in technology and communication, expanded the range of the services and products offered, streamlined their systems of administration and risk management and involved in Mergers and Acquisitions (M&As) as well as in internationalization activities (Kosmidou and Zopounidis, 2008, Pasiouras, 2012).

Per the International Monetary Fund (IMF) on its report for Greece, the solvency and liquidity indicators of the Geek banking industry were sound when the recent financial crisis hit forcibly the Greek economy (IMF, 2010). However, the sovereign downgrades that followed, forced them to collapse. The sovereign downgrades escalated the uncertainty resulting in withdrawals of bank deposits and deleveraging – which were interrelated –, contributed to a sharp increase of problem loans deteriorating the ominous situation faced by the banking institutions and deepened recession (Provopoulos, 2014).

In May 2010, the European Central Bank (ECB), the IMF and the European Commission announced the launch of the first Economic Adjustment Programme of €110 billion for Greece. Two more financial assistance packages followed; one in February 2012 (€109 billion) and one in August 2015 (€86 billion).

Concentrating on the banking institutions, the ever worsening economic situation resulted in rating downgrades of the Greek banks blocking the latter out of the

international financial markets, raising impediments in their efforts to recover their financial activities, hence aggravating their ability to provide liquidity to the economy. In order that financial stability and deposits safety to be ensured, the short-term liquidity needs of the banking institutions were covered through the Emergency Liquidity Assistance (ELA) with progressively increasing amounts which reached up to €125 billion in June 2012[1]. Also, in 2011, as result of holding large amounts of Greek sovereign bonds in their bond portfolios, the Greek banking institutions suffered significant losses on their bond portfolios, due to their participation in the Private Sector Involvement (PSI) programme, which intended in the restructuring of the Greek sovereign debt. PSI resulted in the decline of the Greek bonds nominal value by almost 53.5%, thereby the four systemically important banks of Greece, which constitute the dataset of this paper, announced losses of almost €28 billion (Gortsos, 2016).

The enormously tough problems the Greek banking sector faced negatively affected its resilience towards adverse developments. The results of the subsequent stress tests and the capital needs assessment that conducted by the regulatory authorities revealed huge capital shortfalls for the four dominant banks (see Appendix A). Therefore, three rounds of recapitalization followed in order that the orderly function of the banking sector to be restored and stability of the financial system to be ensured.

Among the key components of the first financial assistance programme was the establishment in 2010 of the Hellenic Financial Stability Fund (HFSF), financed with the amount of €10 billion[2], in order to inject equity into the Greek banking institutions and, consequently, to fortify the soundness of the financial system. After the contribution of HFSF to the first recapitalization of the banking institutions (see paragraphs 5.1.1 and 5.1.3 for more details), it became their dominant shareholder. HFSF did not participate in their subsequent capital increases, thus its share on their capital diluted (see Appendix B).

The uncertainty that prevailed in the first half of 2015, mainly due to the protracted negotiations with the official creditors, and, consequently, the large deposits outflow

[1] Since 2013, a gradual reduction of the ELA amount began reaching zero amount in May 2014. However, there was an increase during 2015 (July 2015: €88.3 billion)

[2] In March 2012, HFSF's capacity was expanded to a total of €50 billion

from the Greek banking institutions, obliged the Greek government to take all the necessary emergency measures. On June 28, 2015 the Greek government declared capital controls and bank holiday – the latter lasted until July 19, 2015 – for all credit institutions operating in Greece.

2.1.1 Key Characteristics

The size of the banking system in Greece, being measured by the ratio of the total assets of the credit institutions to Gross Domestic Product (GDP), almost doubled over the period 2002-2015.

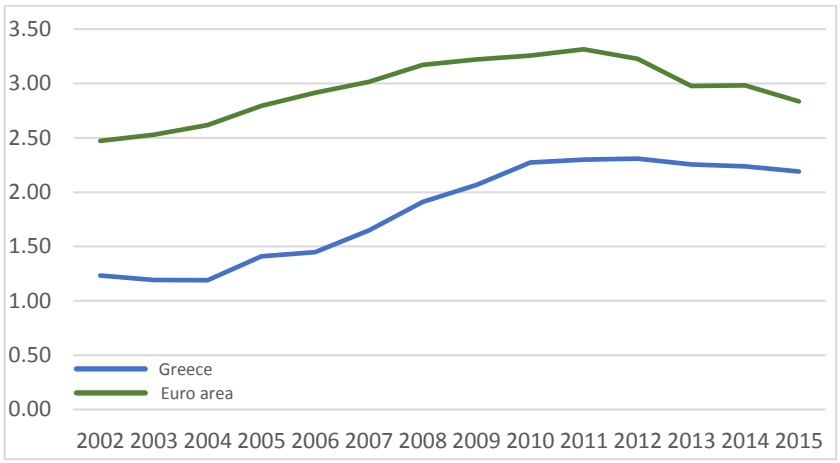

Figure 2.1: Total assets of the credit institutions (% of GDP)

Source: Based on data from the Bank of Greece and Eurostat

As illustrated in Figure 2.1, the depth of bank intermediation was 2.19 times GDP in 2015 compared with 1.23 times GDP in 2002.

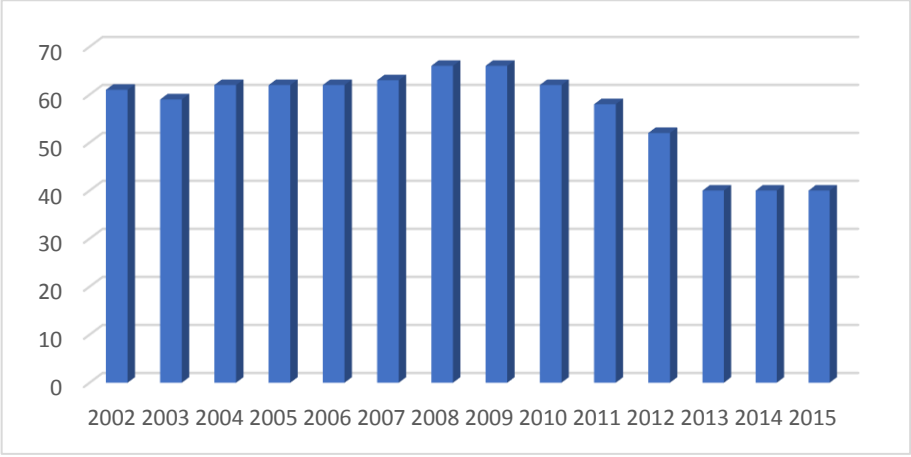

Figure 2.2: Credit institutions legally incorporated in Greece

Source: Based on data from the European Central Bank

However, regarding the number of the credit institutions operating in Greece, a large decrease is reported from 61 in 2002 to 40 in 2015 (Figure 2.2). Data from the Hellenic Bank Association (HBA) and ECB report that the credit institutions authorized in Greece at the end of 2015 comprised of 18 credit institutions incorporated in Greece –including 9 cooperative banks –, 18 branches of banks incorporated in other European Union (EU) countries and 4 branches of banks incorporated in non-EU countries.

According to the Report on financial structures of ECB in October 2016, the ratio of the assets of the Monetary Financial Institutions (MFIs), – consisting of the Bank of Greece (BoG), the credit institutions operating in Greece and the money market funds – to the total assets of the entire Greek financial sector reached the high level of 91.9% at the end of 2015. With respect to the domestic credit institutions, they controlled 98% of the market share at the end of 2015 while the respective percentage of the cooperative banks was close to 1% over the period under examination.

2.1.2 Significant Organisational Restructurings and Internationalization

The restricted exploitation potential of economies of scale due to the number of the Greek banks in relation to the domestic money market size, the government policies, which were promoting privatization schemes, the pursuit of ways for achieving competition mitigation as well as service and product diversification impelled the Greek banks to M&As schemes (Kapopoulos and Lazaretou, 2011). Another contributing factor towards M&As within the country was the imperative need for the Greek banks to increase in size in order to expand activities in the single EU market – where the level of private bank lending was remarkably lower compared to the Euro area (Kapopoulos and Lazaretou, 2011) – and to gain access to the international financial markets (BoG, 2002). Therefore, the Greek banks expanded operations in the Balkan Peninsula through acquisitions of domestic credit institutions, branch establishment and joint ventures.

However, different incentives arose for a series of restructurings in March 2012 when the main part of the PSI programme[3] implemented and the Greek banks continued to experience substantial losses. The restoration of the banking and financial system stability was contingent on the recapitalization of the Greek banks, thus a new wave of

[3] After the exchange of the old Greek bonds under PSI completed, the trading of the new Greek bonds started on March 12, 2012

acquisitions and consolidation processes (see Appendix C) among the Greek banking institutions unfolded (Rompotis, 2015). Therefore, the Greek banking sector was radically restructured and ended up with four systemically important banks accounted for almost 95% of the respective market at the end of 2015. Similar pattern of de-escalation of the internationalization activity of the Greek banks is, also, observed from 2012 onwards (see Appendix D).

2.2 Macroeconomic environment

Examining thoroughly the macroeconomic environment within Greek banks operate is of ultimate importance in order to fully comprehend their decision-making procedures and the evolution of their performance.

2.2.1 Gross Domestic Product

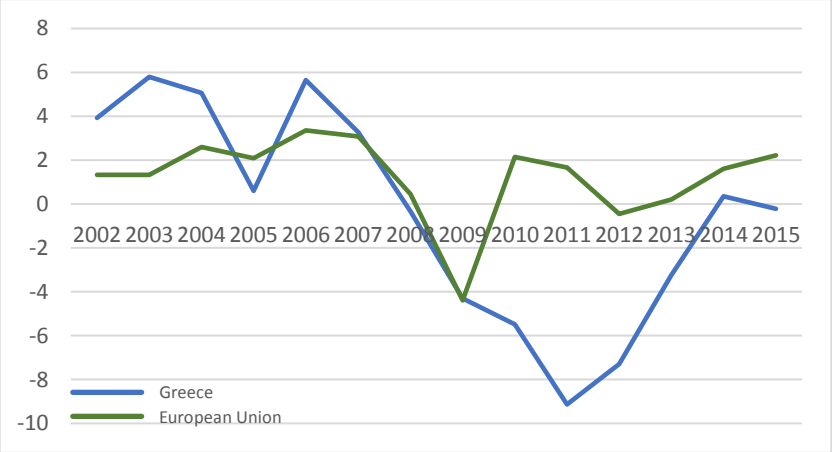

Figure 2.3: GDP growth (annual %)

Source: Based on data from the World DataBank

The high GDP growth rate until 2007 is attributable, according to the Annual Report of BoG for the years 2006 and 2007, in investments and structural reforms, such as the entry of Greece into the Eurozone and the inflow of resources from the EU Structural Funds, which boosted production capacity and domestic demand. The turmoil in international financial markets in 2008 had a negative impact on the Greek macroeconomic aggregates and uncloaked structural weaknesses and macroeconomic imbalances of the Greek economic sector, as clearly depicted in Figure 2.3. Since 2009, the GDP growth rate in Greece lagged the respective indicator of EU due to a sharp decline in private consumption and investments, as well as due to the prevailing political

instability especially since the beginning of 2015, the bank holiday in June 2015 and the subsequent imposition of capital controls.

2.2.2 Inflation

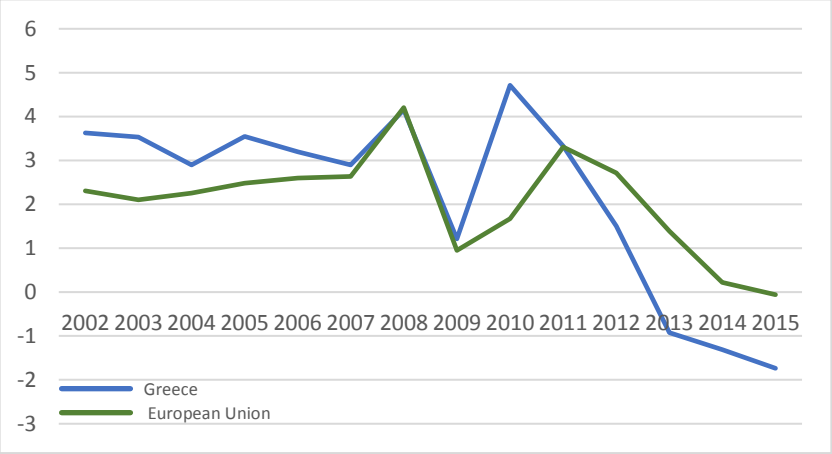

Figure 2.4: Inflation, consumer prices (annual %)

Source: Based on data from the World DataBank

As mentioned in the Annual Report of BoG for 2007, the persistently higher inflation rates in Greece, compared to the corresponding in EU, during 2002-2007 are mainly due to macroeconomic indicators like the excess demand and the higher unit labour cost growth in Greece compared to EU as well as due to operational efficiencies in certain markets, which were in favor of high profit margins. The volatility of the inflation rate in 2008-2009 is attributed to the volatility of oil and other commodities prices during the respective period. However, in 2009 the inflation rate declined further due to a sharp decrease in aggregate demand as a consequence of the austerity measures imposed as a prerequisite of the first Economic Adjustment Programme. The increase in indirect taxes in 2010 is the main cause for the corresponding increase in inflation while BoG reports that the following declining trend from 2011 to 2015 is due to the attenuation of the impact of the high indirect taxation, to the slightly lower increase in oil prices and to the sharp decline in unit labour costs and consumer demand (see Figure 2.4).

2.2.3 Unemployment

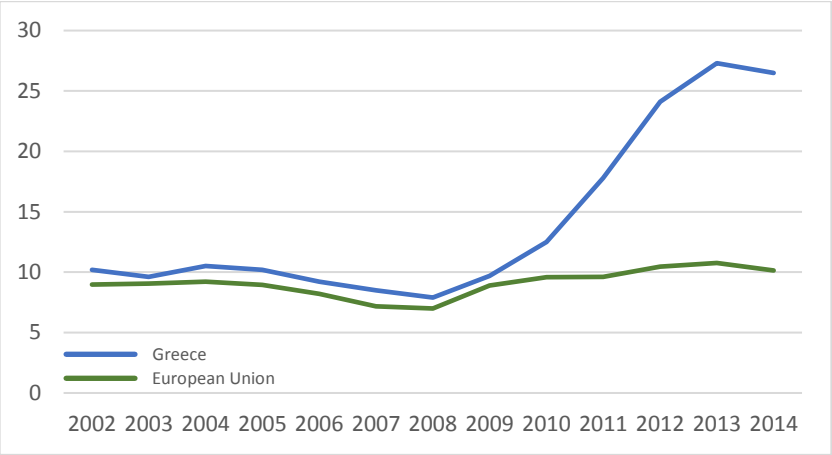

Figure 2.5: Unemployment, total (% of total labour force)

Source: Based on data from the World DataBank

Figure 2.5 clearly illustrates the unemployment rate in Greece to be steadily higher than the respective rate in EU over the period under examination. However, since 2009 and as the recession was deepening in Greece, due to the ominous problems sourced from public debt and due to the effects of the Economic Adjustment Programmes applied, the unemployment rates skyrocketed (Karafolas and Alexandrakis, 2015). Other key factors towards the same direction were, according to the Annual Report of BoG for the years 2010 and 2011, the attenuation in domestic and external demand, the decline in production as well as the pursuit of ways by the enterprises to boost competitiveness.

2.2.4 General Government Debt

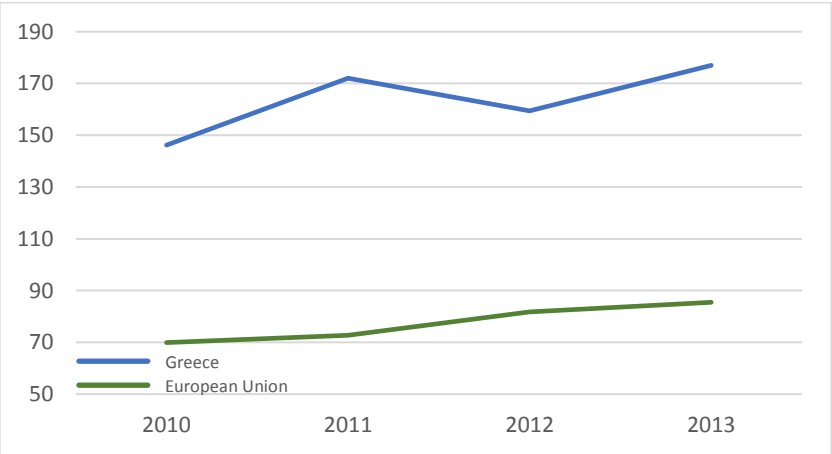

Figure 2.6: General government debt, total (% of GDP)

Source: Based on data from the World DataBank and Bank of Greece

After the upward revision of the general government debt to GDP ratio for the period 2006-2009, the respective percentage reached the level of 146.2% in 2010 highlighting ingrained problems in the expenditure control and tax collection mechanisms. A slight improvement during the two-year period 2011-2012 (see Figure 2.6) is due to the decline in interest rates on the loans extended under the first Economic Adjustment Programme, to the approval of the bond buyback operation per the Eurogroup decisions at the end of 2012, as well as to the implementation of the PSI programme. Next, the general government debt to GDP ratio followed an upward trend reaching 177.0% in 2013 – mainly due to the financing of the recapitalisation of the Greek banks through HFSF and the extra borrowing of the Greek government with €6.5 billion (BoG, 2011; BoG, 2013; BoG, 2014) – 178.6% in 2014 and 180.2% in 2015 (provisional data).

2.2.5 Trade Balance

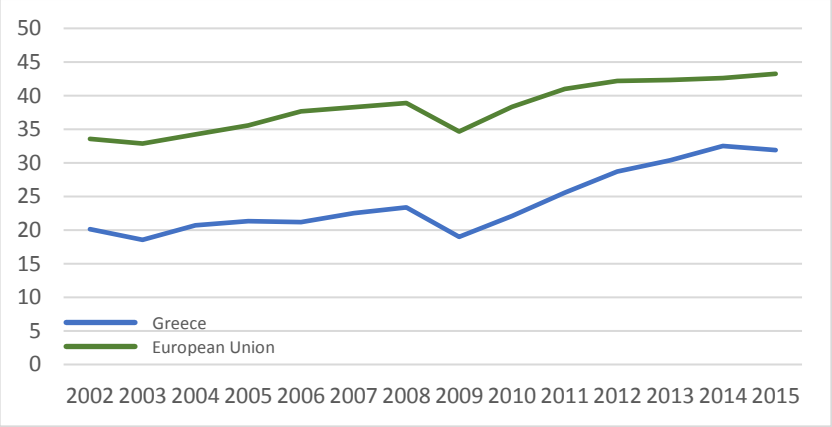

Figure 2.7: Exports of goods and services (% of GDP)

Source: Based on data from the World DataBank

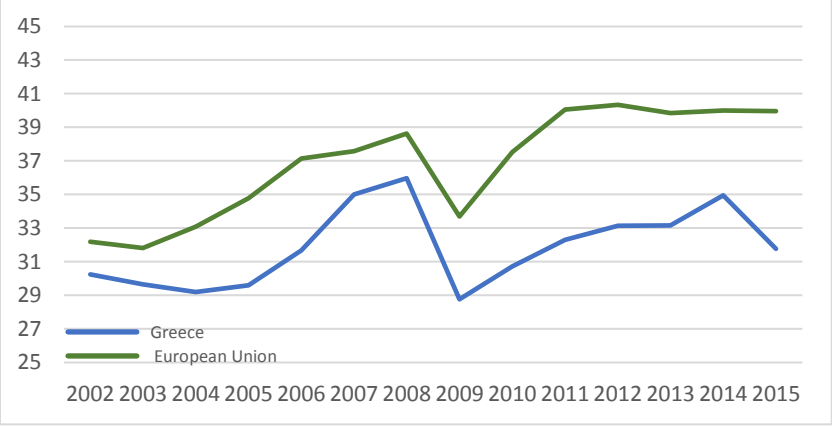

Figure 2.8: Imports of goods and services (% of GDP)

Source: Based on data from the World DataBank

A favorable development during the period under examination was the upturn in exports of goods and services. In 2012 a positive contribution of the external sector to GDP growth was recorded – because the rate of increase (decrease) in exports was higher (lower) than that in imports – and lasted until 2015 (see Figure 2.7 and 2.8).

Overall, the multifaceted and harsh environment within Greek banks operate, with serious implications on bank performance, is clearly highlighted.

2.3 Regulatory Framework

With respect to the issue of micro-prudential regulatory interference in the operation of the banking institutions, the Basel Committee on Banking Supervision (BCBS) took action aiming to the international convergence of the rules under which the calculation and fulfillment of capital requirements for the banks operating internationally is accomplished so as the latter to be safeguarded against exposure to various risks. The result was the introduction of two Accords; the Basel I in 1988 and the Basel II in 2004.

The Basel I sets the minimum capital ratio of capital to Risk-Weighted Assets (RWA) at 8% establishing a uniform approach on risk measurement, thus obsoleting origins of competitive imbalances and safeguarding banking system stability at international level. In a very short time Basel I framework became the standard which all countries as well as major banks adopted (Goodhart, 2011).

The Basel II establishes a new framework for capital adequacy and introduces considerably more risk-sensitive capital requirements, however the minimum threshold of 8% is retained (see Appendix E). The Basel II comprises three pillars: (i) minimum capital requirements, which are designed to elaborate and evolve the established regulatory framework by the Basel I, (ii) supervisory assessment procedures for the capital adequacy level and internal evaluation procedures and (iii) efficient use of disclosure so as to reinforce market discipline and embolden sound practice in banking (BCBS, 2015). However, Balin (2008) argues that this Accord is extremely long and complicated.

The recent financial crisis advocated the introduction of the Basel III which entails the existence of the Basel I and the Basel II. The Basel III reinforces micro-prudential regulatory interference in bank operation by imposing new requirements regarding

capital adequacy as well as leverage and liquidity ratios (see Appendix E). Its innovation lies in the fact that it introduces a macro-prudential approach in tackling with the systemic risk (Gortsos, 2011). This is the reason why Hannoun (2010) introduces an equation which indicates that Basel lll "equals" the enhanced Basel ll plus the macro-prudential overlay. According to BoG, the implementation of the Basel lll – incorporated in the EU law on June 26, 2013 with the Capital Requirements Directive (CRD IV) – is in progress since January 1, 2014 and its completion is expected in 2019.

3. Literature Review

There are two groups of studies focused on bank performance; the former aims to evaluate bank performance and gain insight into the different performance aspects of the Greek banking sector and the latter concentrates on the study of the factors which determine bank performance.

3.1 Evaluating bank performance

The relevant Literature Review reveals a progressively improving trend of Greek banking sector performance from 1993 until 2009, when the recent financial crisis erupted.

In more detail, studying cost structure and productivity in a way to evaluate and quantify Greek banking sector performance over the period 1993-1998, Tsionas et al. (2003) reach to the conclusion that most of the Greek banks follow best market practices in terms of overall efficiency reaching the level of almost 96%. In particular, technical efficiency reaches the level of 98.4% while allocative efficiency reaches the level of 97.4%, on average. Also, with respect to the intertemporal performance of the whole Greek banking sector, their findings show an increase of 2.3% in overall efficiency for the period 1993-1998.

In accordance with Tsionas et al. (2003), Siriopoulos and Tziogkidis (2010) indicate that, during the period 1995-1998, Greek banking sector efficiency is boosted while the same conclusion applies for the period 1999-2003. Siriopoulos and Tziogkidis (2010) go further and indicate that, in most cases, the efficiency of the Greek banks deteriorates after significant events, like M&As and the crisis of the Athens Stock Exchange (ASE) in 1999. However, a period of recovery follows while the restoration of efficiency to the pre-event levels requires two to three years. Finally, management performance during the restoration periods is efficient, on average. Examining a wider period and arguing that profit efficiency constitutes the primary goal of banking institutions and that long-run profit efficiency is heavily dependent on the levels of cost efficiency, Delis et al. (2009) are in accordance with the previous studies (Tsionas et al., 2003; Siriopoulos and Tziogkidis, 2010) and conclude that both profit and cost efficiency follow an improving trend during the period 1993-2005. Additionally, they indicate that profit efficiency is remarkably higher compared to cost efficiency.

The deteriorating trend of Greek banking sector performance is highlighted in the study of Georgantopoulos and Tsamis (2013) that focuses on the period of crisis during 2007-2011, uses financial ratio analysis and investigates financial performance of a group of commercial banks, which corresponds to more than 70% of the Greek banking sector in terms of total assets during the period under examination. Among their inferences is that the selected banking institutions are unable to generate profits by exploiting shareholders' equity, by utilizing costumer deposits or by converting total assets into net profits, thus a declining trend in bank performance is highlighted. However, a positive development is the increase in total assets by 9.40%, on average. Another study that focuses on a similar time span and reaches similar conclusions is the study of Chatzi et al. (2015). They use the CAMELS framework (the acronym CAMELS stands for Capital Adequacy, Asset Quality, Management Capabilities, Earnings Quality, Liquidity and Sensitivity to Market Risk) in order to examine the period 2006-2012 and indicate, in contrary to Georgantopoulos and Tsamis (2013), that overall efficiency of the publicly traded banking institutions follows an upward trend during 2006-2009 – especially in 2007. Yet, in accordance with Georgantopoulos and Tsamis (2013), a downward trend follows during the four-year period 2009-2012. They conclude that the study of changes in the economic environment as well as of the emergence of new risks should be involved in the procedures of evaluating bank efficiency.

3.2 Recognizing the determinants of bank performance

With respect to the Greek banking sector, the majority of the research papers, aiming to clearly identify the determinants of bank performance, use regression techniques where they set as dependent variable efficiency measures or performance indicators, like Return on Equity (ROE) and Return on Assets (ROA) (Pasiouras, 2012).

Additionally, the relevant Literature Review (Staikouras and Wood, 2004; Athanasoglou et al., 2008; Kosmidou, 2008; Alexiou and Sofoklis, 2009) argues that the determinants of bank performance can be categorized into internal, which are under the influence of bank management, and external, like the conditions in the economy and bank industry, which are not under the influence of bank management.

Arguing that the type of the banking institution is a key determinant of bank performance, Kosmidou and Zopounidis (2008), in a performance evaluation of the

Greek commercial and cooperative banks during the period 2003-2004, use financial ratios and conclude that the commercial banks tend to become more competitive and succeed in profit maximization. For the cooperative banks the results are not uniform since there are banks which manage to increase their market share and profits and others which are not successful in their attempts to improve performance. Schiniotakis (2012), who attempts to recognize the profitability factors of the Greek commercial and cooperative banks and focuses on the different, turbulent period of 2004-2009, confirms that the type of the banking institution is a key determinant of bank profitability and proves that, at the beginning of the crisis, the commercial banks were more influenced by the severity of the crisis than the cooperative banks.

The international or not activity of the Greek commercial banks is, also, examined by Pasiouras (2008) as a determinant of bank performance. In particular, Pasiouras (2008) focuses on the period 2000-2004 and finds that the Greek commercial banks which operate abroad are more technically efficient than those restricting operations at national level.

Noulas (2001) examines the ownership status of the banking institutions as a determinant of their operating efficiency under the effect of deregulation in the Greek banking sector over the period 1993-1998. Using both the traditional method, which involves the examination of certain ratios to measure performance, as well as the Data Envelopment Analysis, he finds that the private institutions are more efficient than the state-controlled institutions. However, the difference in the levels of efficiency for the period 1996-1998 is not statistically significant and this inference implies that the above mentioned banking groups competed on an equal footing within the deregulation framework. Similarly, Eichengreen and Gibson (2001), who consider three measures of profitability – ROA, ROE and ROA plus off-balance sheet items – and investigate the period 1993-1998, find that ownership status does not affect significantly profitability while Athanasoglou et al. (2008), who investigate the period 1985-2001, reach to the same conclusion.

Following Rezitis (2006), who sheds light on Greek banking sector performance during the period 1982-1997 and clearly argues that productivity growth over time indicates performance of an industry, the implied internal determinant of bank performance under examination is labour productivity. Rezitis (2006) claims that the components of

productivity growth are technological change and technical efficiency change while the components of technical efficiency change are pure technical change and scale efficiency change. Eichengreen and Gibson (2001) and Athanasoglou et al. (2008) prove that growth in labour productivity have a robust, positive effect on profitability. However, Alexiou and Sofoklis (2009), who study the determinants of profitability of the six most significant Greek commercial banks during 2000-2007, unexpectedly find a negative and significant relation between profitability and productivity. The explanation they provide is that, regarding the assets under management of the Greek banking institutions, the optimum employees number has not yet been reached, thereby it is of paramount importance voluntary retirement schemes to be continued.

The size of the banking institution is the most debated determinant of bank performance. The increasing bank size and, consequently, the emergence of bureaucratic issues may offset the positive impact of the bank size on profitability (Alexiou and Sofoklis, 2009). According to Rezitis (2006), pure as well as scale efficiency are favorably affected by the size of the banking institution. Examining the period of 1993-1998, Christopoulos et al. (2002) indicate that small and medium-sized institutions are more efficient than large ones and come in conflict with the findings of Tsionas et al. (2003), who focus on the same period as the study of Christopoulos et al. (2002) and prove that small and especially medium-sized banks are less efficient than larger ones. However, Eichengreen and Gibson (2001), who, also, study the same period, reach a different conclusion. Among their inferences is that a bell-shaped relation exists between profitability and the bank size, suggesting that an increase in profitability is followed by a decrease up to the mean size. Kosmidou (2008), who studies the Greek banking industry during 1990-2002 and focuses on the performance measure of Return on Average Assets (ROAA), reveals a positive relationship between ROAA and the bank size, however the bank size is proved to be statistically significant only after involving into the models the variables which describe the financial structure and macroeconomic framework. Similar conclusions derive from Athanasoglou et al. (2008) and Schiniotakis (2012) who prove that the bank size is insignificant in making difference to profitability. Therefore, the effect of the bank size on performance is controversial and, consequently, safe and robust conclusions are not possible to be reached.

Cost to Income Ratio (CIR) is another internal determinant of bank profitability. Kosmidou (2008) and Alexiou and Sofoklis (2009) agree on a significant and negative relationship between bank profitability and the level of CIR.

Eichengreen and Gibson (2001), Athanasoglou et al. (2008), Kosmidou (2008), Pasiouras (2008) and Schiniotakis (2012) investigate the effect of capital adequacy on bank profitability. They unanimously reach the conclusion that a significant and positive relationship exists between bank performance and well capitalized banking institutions. Additionally, vulnerability to credit risk unsurprisingly affects in a significantly negative manner the profitability levels according to Athanasoglou et al. (2008), Kosmidou (2008) and Alexiou and Sofoklis (2009).

Finally, liquidity is found to have a controversial effect on bank profitability. Eichengreen and Gibson (2001) find that liquidity is significantly and positively associated with bank profitability whereas Alexiou and Sofoklis (2009) reveal a highly significant and negative relationship.

Other internal determinants of bank performance are the degree of specialization of the banking institution (Rezitis, 2006), the staff costs (Eichengreen and Gibson, 2001), the personnel to branches ratio (Schiniotakis, 2012) and the number of branches (Pasiouras, 2008).

As far as the external determinants of bank performance are concerned, GDP is examined in numerous studies, however its impact on bank performance is ambiguous. Staikouras and Wood (2004) reveal a significant and negative association between bank profitability and GDP, Kosmidou (2008) reveals that this association is significant and positive whereas Alexiou and Sofoklis (2009) reveal that this association is highly insignificant and positive.

Inflation is another macroeconomic control variable examined in the majority of the studies which attempt to recognize the determinants of bank performance. Athanasoglou et al. (2008) reveal a robust and positive effect of inflation on bank performance justified by the faster decreasing rate of interest rates on deposits compared to that on loans within the disinflation process that the economy of Greece passed through during the period under examination of this study. Alexiou and Sofoklis (2009) confirm that this relation is positive, however they prove that the effect on bank

performance is not significant. On the contrary, Kosmidou (2008) finds that inflation is correlated with bank performance in a robust and negative manner.

Furthermore, the level of concentration in the Greek banking industry has, according to Eichengreen and Gibson (2001) and Athanasoglou et al. (2008), insignificant impact on profitability. However, Kosmidou (2008) disagrees and reveals that market concentration and bank profitability are significantly and negatively correlated.

Other external determinants of bank performance are the private consumption (Alexiou and Sofoklis, 2009), the money supply growth and the ratio of stock market capitalization to bank assets (Kosmidou, 2008).

The Literature Review chapter reveals that gaining insight into the different aspects of bank performance has motivated numerous studies while the methodology and the variables used are considerably diversified. With respect to the above mentioned relevant Literature Review and to the best of our knowledge, there is no previous published paper covering such a wide time span and including the most recent data. Thus, this paper studies the full period after the inception of Euro currency in 2002 until the current sovereign and banking crisis and evaluates the PSI effect on Greek banking sector performance, having sufficient available data over the three-year period 2013-2015 so as to extract safe conclusions. Additionally, this study seeks to confirm if the determinants of bank performance, on the effect of which the relevant Literature Review agrees upon, have consistently the same effect on bank performance before and throughout the recent financial crisis.

4. Research Design

This chapter constitutes an inclusive description of the sample of the banks selected as well as of the empirical methodology followed, the data collection procedure and the variables selected in the different parts of this study.

4.1 Determination of the sample of the banks

The four dominants, systemically important commercial banks of Greece, namely Alpha Bank, Eurobank, NBG and Piraeus Bank, constitute the sample of this study due to the large share of the Greek credit institutions' total assets that they possess during the period under examination. In particular, since 2002 they account for more than 60% of the credit institutions' total assets, since 2007 for more than 67% while, after the restructuring of the Greek banking industry in 2012, the respective percentage reached the level of 87% in 2013 and the level of 95% in 2015. Therefore, the above mentioned four banks represent satisfactorily the entire Greek banking sector while they are homogenous regarding the type and range of the services offered and their sensitivity to the developments of the macroeconomic aggregates of Greece. Finally, the selected banks comply with further filtering criteria employed in this study; all the Greek commercial banks consisting the present study's dataset i) should be listed in ASE during the period 2002-2015 and ii) should have not been liquidated or merged during the same period.

4.2 Empirical Methodology, Data Collection Process and Variables Selection

4.2.1 Financial Ratio Analysis

In order that the first objective of this paper to be fulfilled, i.e. the empirical examination of Greek banking institutions performance over the period 2002-2015, the financial ratio technique is employed. This technique involves the calculation of financial ratios of relevant accounting variables in order that one accounting variable to be standardized by another one which is economically relevant. Halkos and Salamouris (2004) and Kosmidou and Zopounidis (2008) argue that the financial ratio analysis is a frequently applied technique in the banking sector through which bank performance analysis is facilitated. On the contrary, Simko et al. (2014) report that financial ratio analysis lacks

timeliness, disregards the current market value of a bank and may be biased since it is based on data from the financial statements. However, they argue that the financial ratio technique enables valid comparisons of operating performance to be accomplished over time as well as among comparable firms. It is worth mentioning that a very similar method widely used for evaluating bank performance is the CAMELS rating system, which is based on the assessment of the six critical elements (capital adequacy, asset quality, management capabilities, earnings quality, liquidity and sensitivity to market risk) of the banking institutions operation using financial ratios. However, Greenbaum and Thakor (2007) argue that the CAMELS framework is more informative during stable time periods rather than during turbulent periods in the banking industry. Therefore, involving the CAMELS framework in the present study is not considered advisable.

The Bankscope Database and the relevant annual financial reports and Pillar lll reports of the selected banks are involved in order that the required annual accounting measures and financial ratios related to the fourteen-year period 2002-2015 to be collected. The source of the respective ratios of the Euro area banking institutions is the World DataBank.

In order to select the financial ratios which frame this study, the guidelines of the ECB (2010) are followed. In particular, the ECB (2010) concludes that the examination of profitability, efficiency, capital adequacy, asset quality and liquidity constitute an integral part of a robust framework towards the objective of a complete and in-depth bank performance analysis. Additionally, the same study insists that the investigation of only one aspect of bank performance is not sufficient towards this objective.

Following Kosmidou (2008) and Eichengreen and Gibson (2001), this study employs Return on Average Equity (ROAE) and ROAA in order to examine the aspect of profitability. Besides, these indicators are commonly used by bank management teams in their reports designed to inform analysts and investors on the aspect of bank profitability. ROAE is estimated by dividing profit (loss) after tax by the average of shareholders' equity and it is a measure of the return generated by the bank for its equity investors. ROAA is estimated by dividing profit (loss) after tax by the average of total assets and it is a measure of the return generated on the investments of the banking institution in assets from any source. The reason for using the average of

shareholders' equity and the average of total assets as denominators in the formulas of the respective financial ratios is that this way any substantial changes over a fiscal period in the shareholders' equity and/or total assets are effectively captured. Additionally, Net Interest Margin (NIM), the ratio of net interest revenue over total earning assets, which is characterized by ECB (2010) as a traditional measure of profitability, is also employed in this study. The high significance of the intermediation operations of the banking institutions and the inherent features of NIM, which render this indicator a proxy for the banking institutions' ability to generate income from intermediation operations, highlight the significance of including this indicator in this part of the study.

ECB (2010) recommends that CIR is a suitable ratio in order that bank efficiency to be examined. CIR, the ratio of operating expenses over operating revenues[4], presents the ability of the banking institution to generate returns from a given stream of revenues. Therefore, CIR constitutes a measure of the cost in relation to income and it is appropriate in order that efficiency in expenditure management to be assessed. The implied relationship between operating expenses and profitability is negative – as operating expenses increase, profitability tends to decline. Also, the banking institutions that are classified as efficient are expected to exercise their activities at lower cost. However, it should be always acknowledged that operating revenues are generated through greater volume of banking activity which is associated with greater operating costs.

Capital adequacy is examined under the Capital Adequacy Ratio (CAR), an international standard that acts as a deterrent factor against potential risks and as a determinant of the critical decisions of the banking institutions (Christopoulos et al., 2011). Capital adequacy pertains to the sufficiency of the equity amount in order that potential shocks to be effectively absorbed. The banking institutions which are adequately capitalized encounter lower risks of going bankrupt thus they manage to effectively reduce cost of funding (Kosmidou, 2008). CAR is calculated by dividing the total amount of bank's

[4] Impairment charges are excluded from the numerator

capital – which is the sum of Tier 1 Capital[5] and Tier 2 Capital[6] – with its RWA. Tier 1 ratio and Common Equity Tier 1 (CET1) ratio[7] – Tier 1 Capital is further divided into CET1 Capital and Additional Tier 1 Capital – complement the investigation of the capital adequacy aspect of bank performance.

In order to investigate asset quality, this study follows Beck et al. (2013) who use the Non-Performing Loans (NPLs) ratio[8] – the ratio of NPLs over gross loans – as the dependent variable in their attempt to reveal the determinants of asset quality. A deterioration of the loan portfolio increases costs for provisions, thereby impairs net profits and eventually affects negatively the banking institutions' solvency indicators. Therefore, the NPLs ratio is proposed as a way to examine and assess the credit risks which are related to the loan portfolios of the banking institutions.

Finally, Alexiou and Sofoklis (2009), in accordance with ECB (2010), examine the aspect of liquidity and involve the Loans to Deposits ratio (LDR) in order to evaluate liquidity risk. This ratio reveals to what extent the banking institution retains its deposits in order to issue new loans and, thus, to what extent the banking institution is dependent on interbank markets. Therefore, this ratio is apt for assessing the ability of the banking institutions to encounter changes related to the sources of funding. Lower figures of this ratio signify higher liquidity. Intuitively, the higher the liquidity levels of a banking institution the higher its profitability. However, there is a trade-off between liquidity

[5] Tier 1 Capital consists of shareholders' equity, share premium, retained earnings, preference securities and preferred shares

[6] Tier 2 Capital consists of subordinated loans with fixed-term cumulative dividend right

[7] Similar to the way of calculation of CAR, Tier 1 ratio is the ratio of Tier 1 Capital over the respective RWA and CET1 ratio is the ratio of CET1 Capital over the respective RWA.

[8] In 2013 the European Banking Authority (EBA) developed the definition of Non-Performing Exposures (NPEs) to ensure uniformity in the measurement of this critical asset quality indicator and foster conformity in the disclosure and reporting procedures by banking institutions and supervisory authorities respectively. Therefore, under the current framework of EBA and the regulations of BoG, NPEs include exposures past due over 90 days, exposures unlikely to be repaid not past due or past due <= 90 days and all impaired or defaulted exposures regardless of whether they have been placed in process of bankruptcy or not. The difference between the NPLs ratio and the NPEs ratio is that the latter includes the exposures unlikely to be repaid not past due or past due <= 90 days (BoG, 2016).

and profitability. Other things being equal, as the resources to satisfy liquidity needs increase, profitability is expected to decrease. Furthermore, because the liquid assets that the banking institutions hold in order to meet potential liquidity requirements are, usually, linked with lower rates of return, a negative impact on profitability is implied (Kosmidou, 2008).

4.2.2 Multiple Regression Analysis

The next two objectives of this study – to evaluate statistically significant relations between bank performance and the selected financial indicators and to investigate if the latter retain their capabilities related to the interpretation of bank performance under the scope of the recent financial crisis – are fulfilled with the aid of the multiple regression analysis. The multiple regression analysis identifies the relationship between the dependent variable and the specified independent variables. The objective is to detect the linear combination of the independent variables which are correlated with the dependent variable. The focus of this part of the study is again on the fourteen-year period 2002-2015 and on the already defined sample of banks while quarterly accounting measures are, in this case, involved. Therefore, a dataset of 56 observations for each of the 4 banks – 224 observations in total – is utilized. So as the empirical relevance of the stated hypotheses related to the determinants of bank performance to be tested, the framework of this study is provided by the generalized multiple regression model:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} + \varepsilon_i$$

where Y is the dependent variable, β_0 is the Y intercept, k is the number of the independent variables, β_1, β_2,…., β_k are the coefficients of the independent variables X and ε_i is the random error in Y for observation i.

In order that the impact of the recent financial crisis on the Greek banking sector to be analyzed, the fourteen-year period 2002-2015 is divided into two equal subperiods; the pre-crisis period (2002-2008) and the period during crisis (2009-2015). Therefore, the model is estimated using the data of the period before crisis and, separately, using the data of the period throughout crisis.

The Thomson One - Reuters Fundamentals Database is employed in order that the required quarterly accounting measures related to the fourteen-year period 2002-2015

to be collected – the Bankscope Database does not provide quarterly data for the selected banks. Eurostat and BoG are the sources of the required macroeconomic data. The EViews 9 package is used in order that the necessary computations to be carried out.

As far as the performance measures are concerned, this study follows Kosmidou (2008) and uses ROAA as the dependent variable in this part of the study. ROAE is not selected due to the misleading information that provides in a specific year included in the period under investigation (see paragraph 5.1.1). The rationale behind selecting this indicator lies in the fact that the utilization of profit after tax for funding purposes is an incentive for many banking institutions in order to increase return on investment (Georgantopoulos and Tsamis, 2013).

Following the relevant Literature Review, the set of the bank performance determinants is divided into the internal and external determinants.

With respect to the internal determinants of bank performance and in conformity with the relevant Literature Review and the analysis of the paragraph 4.2.1, CIR and LDR are included in the set of the independent variables.

The ratio of Equity to Total Assets (EQTAR) is involved in this part of the study in order that the aspect of capital adequacy as determinant of bank performance to be assessed, due to unavailability of quarterly data for CAR for the whole period under examination. As the ratio increases, the need to external funding is decreased, thus profitability is predicted to increase. Therefore, the majority of the studies (Eichengreen and Gibson, 2001; Athanasoglou et al., 2008; Kosmidou, 2008; Pasiouras, 2008; Schiniotakis, 2012) reveal a positive relationship between EQTAR and profitability.

The Thomson One - Reuters Fundamentals Database and the interim financial statements of the selected banks do not include the data required for the calculation of the NPLs ratio. Alternatively, the ratio of Loan Loss Provisions to Gross Loans (LLPGLR) is involved at this phase of the study as a determinant of bank performance with respect to the aspect of asset quality. Given that the provisions amounts are established considering the probability of loans to turn non-performing, this ratio indicates the estimated reserves for loan losses, which are built by imposing charges to current income, in relation to gross loans. Therefore, this ratio constitutes a reliable indicator of the banking institution's asset quality and, consequently, of its performance. Larger

amounts in provisions denote strong probability of increase in the NPLs ratio, thus poorer asset quality and higher exposure to credit risk. Therefore, higher values of LLPGLR are unwelcome. However, considering the theory or risk-return, a positive relation among risk and profit is expected. But, when asset quality deteriorates, the effect on profitability is expected to be negative due to a decline in interest income revenue and to a rise in provisions costs (Kosmidou, 2008).

Continuing with the explanatory side of the equation and as far as the external determinants of bank performance are concerned, GDP growth (GDPGROWTH), constitutes the first one. GDPGROWTH is an indicator of the overall economic activity within the framework of the economy which influences several coefficients related to the demand and supply of deposits and loans. Per Staikouras and Wood (2004), there are numerous reasons which explain the effect of real GDP on bank profitability. First, the position in the cycle constitutes a determinant factor of the quality of the banking institutions' assets. Also, default risks, which are fewer during upturns, will determine the amount of provisions for loan losses. Therefore, during upturns loan loss provisions are fewer contributing to an increase in profitability, thus a positive relationship is expected to be established between GDPGROWTH and profitability. Additionally, during periods of strong economic growth, increased demand for loans is expected which, in turn, generates high returns for the banking institutions and, consequently, higher profits. However, for Alexiou and Sofoklis (2009) the underlying relation between GDPGROWTH and bank profits is ambiguous. Besides, the relevant Literature Review reaches the same conclusion.

The second external determinant of bank performance included in the set of the independent variables is inflation (INFL) – measured by the Harmonized Index of Consumer Prices – due to its substantial impact on bank performance. The banking operations as well as the profit margins are significantly affected by the interest rates which are, in turn, strongly associated with inflation. Additionally, fluctuations in INFL cause fluctuations in customers demand for various types of financial services. Unanticipated rise in INFL may provoke cash flow constraints, may bear difficulties in loan service, thus may trigger loan losses. Furthermore, when the inflation levels are unpredictable, serious difficulties arise with respect to loan planning and negotiation. However, the banking institutions may take advantage of high and fluctuating inflation

levels in order to invest in property markets seizing the opportunity to achieve high profitability. (Staikouras and Wood, 2004). Therefore, INFL should constitute an integral variable of the explanatory part of the bank performance equation (see Appendix F for variables description).

Table 4.1: Descriptive Statistics for the period 2002-2015

	Mean	Median	Minimum	Maximum	Std. Deviation
CIR	39.454	39.806	4.849	74.672	12.111
EQTAR	6.050	6.404	-5.181	13.055	3.032
LLPGLR	6.120	3.683	1.355	22.812	5.037
LDR	108.468	113.115	-3.910	171.358	27.045
GDPGROWTH	0.452	2.609	14.299	12.800	7.224
INFL	2.205	2.900	-2.500	5.700	2.094
ROAA	-0.258	0.545	-12.370	4.430	3.027

With respect to Table 4.1, the large differences between the minimum and maximum values of CIR, EQTAR, LLPGLR, LDR and ROAA are attributed to the extremely negative effect of the PSI programme on the bank performance aggregates. Furthermore, an interesting remark relates to the large difference between the mean and median value of ROAA. More specifically, the mean value of ROAA is -0.258% while the median value of ROAA is 0.545%. This finding implies the prevalence of a huge profitability gap for the banks constituting the sample of this study.

5. Empirical Findings and Analysis

This chapter constitutes a comprehensive interpretation of the empirical results derived from the financial ratio analysis and the multiple regression analysis which are applied in this study.

5.1 Financial Ratio Analysis

In the following subsections, the five aspects of bank performance (profitability, efficiency, capital adequacy, asset quality and liquidity) proposed by ECB (2010) are thoroughly examined. The analysis is accompanied by tables in each subsection which incorporate the performance of each bank over the period 2002-2015 while the analysis is complemented by the respective figures which are built based on the average values of the selected banks in each year.

5.1.1 Profitability

Table 5.1: Return on Average Equity (%) of the selected banks (2002-2015)

Year/Bank	Alpha Bank	Eurobank	NBG	Piraeus Bank	Average
2002	11.14	9.03	9.01	8.02	9.30
2003	16.37	14.33	15.36	9.24	13.83
2004	17.82	19.19	16.55	14.01	16.89
2005	18.50	18.07	19.24	17.28	18.27
2006	16.45	17.29	16.19	25.08	18.75
2007	21.53	18.50	18.93	25.34	21.08
2008	12.47	13.56	18.86	10.46	13.84
2009	7.04	5.78	10.65	6.19	7.42
2010	1.46	1.35	4.25	-0.62	1.61
2011	-98.32	-157.73	-231.40	-992.29	-369.94
2012	-79.72	-1.313.64	-	-	-696.68
2013	64.12	-59.82	27.67	81.89	28.47
2014	-4.10	-22.09	1.16	-24.86	-12.47
2015	-16.37	-17.19	-41.38	-21.87	-24.20
Average	-0.83	-103.81	-8.84	-64.78	

Source: Based on data from the Bankscope Database

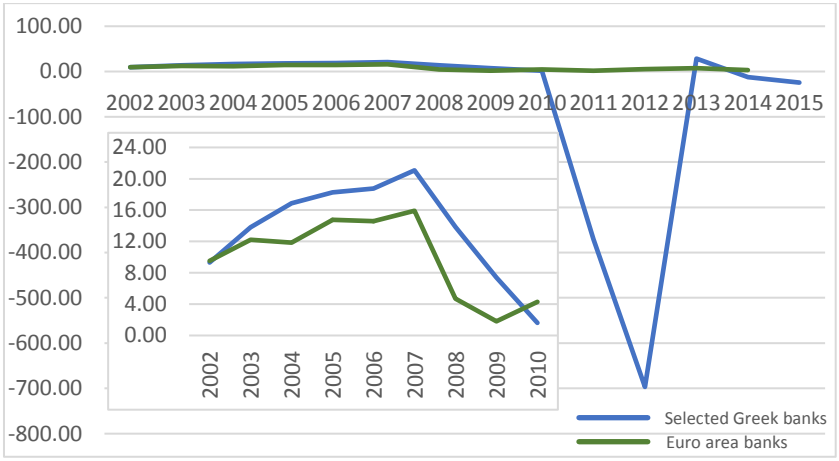

Figure 5.1: Return on Average Equity (%)

Source: Based on data from the Bankscope Database and World DataBank

Until 2007 the selected Greek banks enjoyed high levels of profitability – even higher than those of the Euro area banking institutions (see Figure 5.1) – due to economies of scale resulting from the consolidation of the Greek banking sector. The first serious signs of the upcoming ominous situation came into view in 2009 (see Table 5.1). The deterioration in macroeconomic aggregates during 2009 in Greece and in countries where the Greek banks have expanded operations is the contributing factor towards the lower profitability levels recorded. The main income sources of the banking institutions were negatively affected while the impairment charges significantly increased. Also, the selected banks, having expanded significant operations abroad, suffered an even sharper increase in the impairment charges regarding their international activities.

The following six-year period 2010 - 2015 was exceedingly detrimental for the selected banks. On one hand, the losses from the participation in the PSI programme and from the higher provisions to cover the losses from the growing NPLs, drained their profitability. On the other hand, the interest income remained low mainly due to high NPLs and deleveraging. However, the interest rate costs fell due to the ECB's low interest rates policy and due to the gradual decline in the amount of ELA. Regarding the operating cost, the persistent efforts of the banking institutions to decrease both the general and administrative expenses and the payroll were remarkable. Also, the synergies from the completion of the mergers and the functional absorption of the acquired banks had positive impact on profitability. In particular, the accounting profit in 2013 is mainly due to the negative goodwill of bank acquisitions within the banking system (BoG, 2016). Overall, despite the last mentioned positive developments, the high

pressure the banking sector had suffered, resulted in the accumulation of large losses during the six-year period 2010-2015. ROAE reached, in 2015, the unfavorable level of -24.20%, on average. Therefore, the ability of the banking institutions to generate income utilizing shareholders' equity radically diminished.

An important remark regarding the values of ROAE which are not presented in Table 5.1 is that the information provided is misleading. In 2011 and 2012, the selected banks suffered significant losses in net profits as well as in shareholders' equity. The losses from PSI resulted in the erosion of bank capital and pushed it into negative territory in 2012. The first recapitalization of 2013 involving cash injection from private funds of about €3 billion and State aid, via HFSF, of €18 billion resolved this perilous situation. However, in 2012, both NBG and Piraeus Bank recorded negative values in the average of shareholders' equity, thus the nominator and denominator in ROAE equations for 2012 are negative. Therefore, the results computed for ROAE are misleadingly positive. This is the reason why the respective values are not presented in Table 5.1. Therefore, the examination of profitability for the year 2012 with the aid of ROAA is considered more prudent.

Table 5.2: Return on Average Assets (%) of the selected banks (2002-2015)

Year/Bank	Alpha Bank	Eurobank	NBG	Piraeus Bank	Average
2002	0.62	0.82	0.41	0.60	0.61
2003	0.98	1.05	0.69	0.84	0.89
2004	1.31	1.26	0.77	1.14	1.12
2005	1.31	1.30	1.31	1.40	1.33
2006	1.18	1.24	1.55	1.68	1.41
2007	1.63	1.36	1.97	1.68	1.66
2008	0.86	0.90	1.65	0.65	1.02
2009	0.52	0.38	0.90	0.38	0.55
2010	0.13	0.10	0.38	-0.04	0.14
2011	-6.05	-6.70	-10.83	-12.37	-8.99
2012	-1.84	-2.00	-2.01	-0.85	-1.68
2013	4.43	-1.59	0.75	3.14	1.68
2014	-0.45	-1.56	0.09	-2.18	-1.03
2015	-1.93	-1.55	-3.71	-2.15	-2.34
Average	0.19	-0.36	-0.43	-0.43	

Source: Based on data from the Bankscope Database

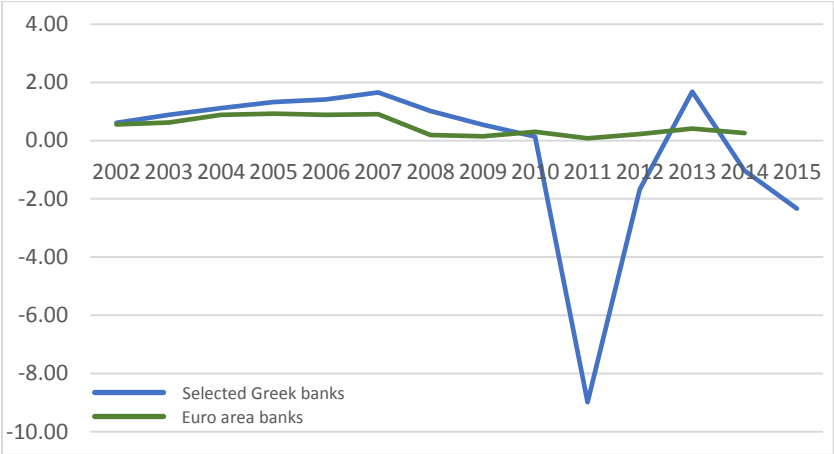

Figure 5.2: Return on Average Assets (%)

Source: Based on data from the Bankscope Database and World DataBank

Turning to ROAA, this indicator presents a similar pattern compared to ROAE (see Figure 5.2). According to the rule of thumb provided by Golin and Delhaise (2013), the five-year period 2004-2008 is characterized by healthy levels of profitability. The deterioration trend began in 2009, as happened with ROAE as well, and reached the extraordinary and significantly negative level of -8.99% in 2011 indicating the failure of asset management to efficiently produce profits. In 2015, Greek banking sector's ROAA reached the level of -2.34%, on average (see Table 5.2).

Table 5.3: Net Interest Margin (%) of the selected banks (2002-2015)

Year/Bank	Alpha Bank	Eurobank	NBG	Piraeus Bank	Average
2002	2.77	3.51	2.36	3.16	2.95
2003	3.22	3.45	2.41	3.04	3.03
2004	3.47	3.70	2.80	3.27	3.31
2005	3.50	3.85	3.10	3.33	3.45
2006	3.34	3.55	3.55	3.07	3.38
2007	3.40	3.59	4.28	2.75	3.51
2008	3.30	3.48	4.31	2.68	3.44
2009	2.84	3.07	4.12	2.31	3.09
2010	2.92	2.86	4.00	2.43	3.05
2011	3.15	2.75	3.85	2.51	3.07
2012	2.61	2.27	3.61	2.03	2.63
2013	2.78	1.96	3.36	2.37	2.62
2014	2.94	2.17	2.06	2.49	2.42
2015	3.10	2.28	2.24	2.53	2.54
Average	3.10	3.04	3.29	2.71	

Source: Based on data from the Bankscope Database

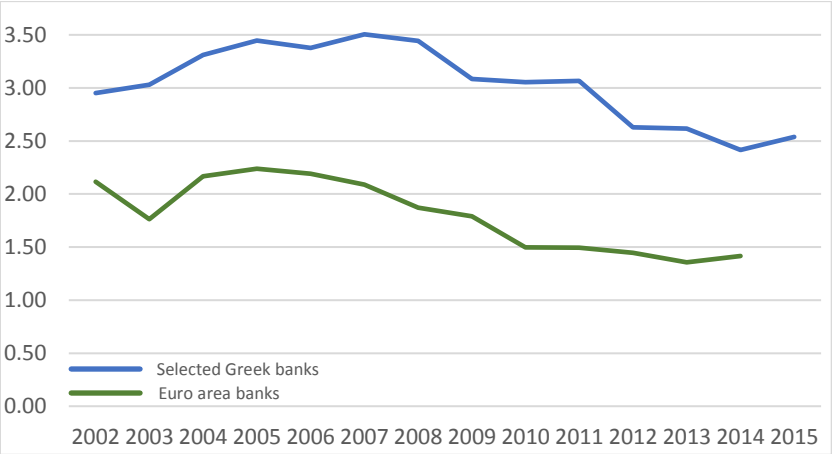

Figure 5.3: Net Interest Margin (%)

Source: Based on data from the Bankscope Database and World DataBank

The intense deceleration in credit growth towards the private sector, the decrease in lending rates as well as the increase in NPLs halted in 2009 the increasing trend of NIM (see Table 5.3). However, the slight increase in interest income, mainly due to the international activities of the selected banking groups, restrained the downward trend during the three-year period 2009-2011 (see Figure 5.3).

Finally, the accumulated deterioration of the macroeconomic aggregates tightened the main income sources of the selected banks and, consequently, narrowed NIM at the level of 2.54% in 2015, on average. However, the NIM levels of the selected Greek banks were remarkably higher than the respective levels of the Euro area banking institutions over the entire period 2002-2015.

Overall, the trend in the profitability ratios reveals that the recent financial crisis significantly prevented the Greek banks to support their operations and their future activities while investors suffered significant losses.

5.1.2 Efficiency

Table 5.4: Cost to Income Ratio (%) of the selected banks (2002-2015)

Year/Bank	Alpha Bank	Eurobank	NBG	Piraeus Bank	Average
2002	64.29	61.50	72.08	70.13	67.00
2003	54.27	54.64	64.94	63.13	59.25
2004	50.15	49.13	59.72	58.64	54.41
2005	48.85	47.47	53.87	58.29	52.12
2006	45.97	46.87	51.56	55.14	49.89
2007	46.01	48.11	52.44	50.65	49.30
2008	50.49	47.89	49.66	53.97	50.50
2009	50.53	48.29	49.74	53.62	50.55
2010	51.05	48.77	54.13	59.03	53.25
2011	48.00	51.53	58.10	67.32	56.24
2012	74.16	60.29	68.88	48.19	62.88
2013	59.14	70.33	68.41	78.52	69.10
2014	63.25	63.20	82.91	59.23	67.15
2015	55.84	62.83	88.20	64.83	67.93
Average	54.43	54.35	62.47	60.05	

Source: Based on data from the Bankscope Database

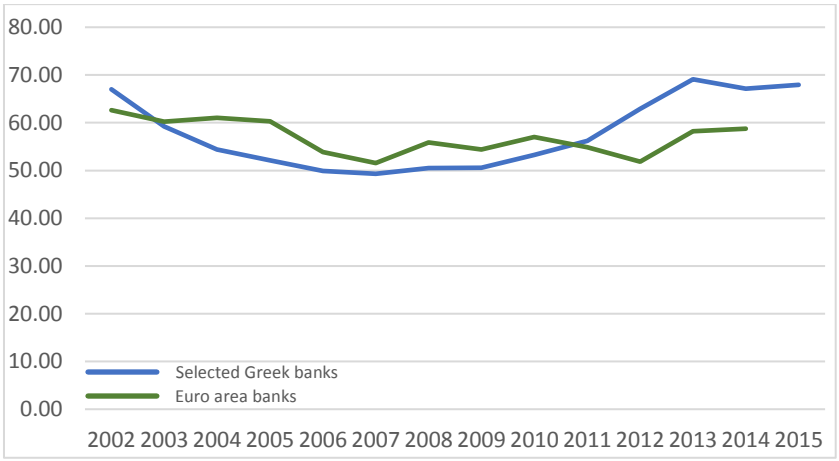

Figure 5.4: Cost to Income Ratio (%)

Source: Based on data from the Bankscope Database and World DataBank

The favorable downward trend of CIR up to 2007 (see Table 5.4) is attributed to the ability of the selected banks to achieve higher operating income growth rates compared to the operating costs growth rates (BoG, 2010). However, this trend reversed in 2008 and CIR began to increase (see Figure 5.4), mainly due to a sharp decline in the selected

banks' operating income, reaching the level of 67.93% in 2015, on average, and surpassing the average of the Euro area banking sector.

5.1.3 Capital Adequacy

Table 5.5: Capital Adequacy Ratio (%) of the selected banks (2002-2015)

Year/Bank	Alpha Bank	Eurobank	NBG	Piraeus Bank	Average
2002	9.80	11.70	10.40	11.65	10.89
2003	14.60	10.40	12.90	11.14	12.26
2004	14.00	10.60	15.60	13.10	13.33
2005	13.50	13.54	15.19	11.00	13.31
2006	12.90	10.40	15.60	11.00	12.48
2007	12.50	12.23	10.20	12.26	11.80
2008	10.10	10.40	10.30	9.90	10.18
2009	13.30	12.70	11.30	9.80	11.78
2010	13.50	11.70	13.70	9.60	12.13
2011	5.40	n.a.*	-2.60	-5.10	-0.77
	9.70**	10.00**	8.30**	8.40**	9.10**
2012	9.40	10.20	6.10	9.70	8.85
	13.40**	11.60**	9.02**	12.20**	11.56**
2013	16.40	11.10	11.20	14.00	13.18
2014	14.60	16.60	13.70	12.50	14.35
2015	16.80**	17.40**	14.60**	17.50**	16.58**
Average	13.22**	12.17**	12.29**	11.72**	

* not available
**includes HFSF's advance payment and/or share capital increase
Source: Based on data from the Bankscope Database and Pillar III reports of the selected banks

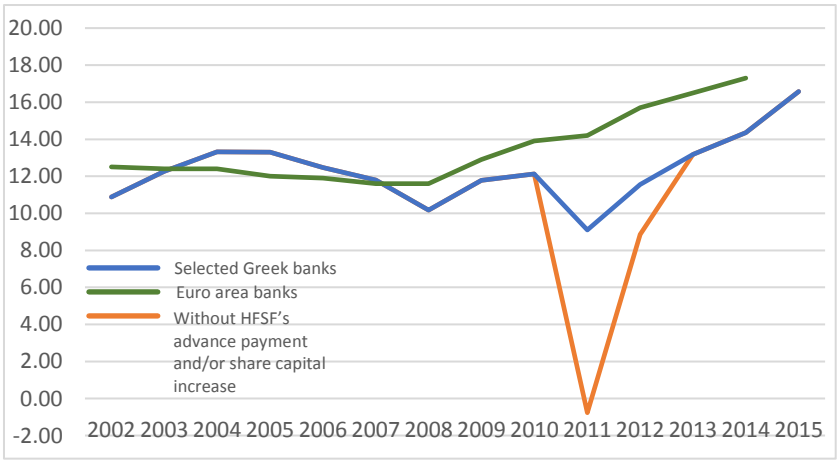

Figure 5.5: Capital Adequacy Ratio (%)

Source: Based on data from the Bankscope Database, World DataBank and Pillar III reports of the selected banks

During 2002-2010, CARs of the selected banks ranged well above the minimum regulatory threshold of 8%. For example, the improvement in the average CAR from 10.18% in 2008 to 11.78% in 2009 (see Table 5.5) is mainly due to a significant rise in regulatory capital whereas RWA increased only marginally.

However, the capital adequacy levels of the selected banks suffered a major blow in 2011 due to their participation in the PSI programme which resulted in recording of losses of about €28 billion. Therefore, in May 2012, HFSF extended €18 billion to the systemically important banks in the form of an advance towards their share capital increase and restored their CARs to the minimum threshold of 8% (see Figure 5.5). The first recapitalization was completed in the first half of 2013. However, the unfavorable evolution of the economic fundamentals of Greece and its secondary effects on the quality of the loan portfolio of the banks led BoG, at the end of 2013, to conduct new stress tests in order to update their capital requirements (see Appendix A). Based on the results, the banks of the sample proceeded, in the first half of 2014, with new capital increases of approximately €8.5 billion, which were fully covered by private funds. The deterioration of the economic climate in 2015 and the extension of the negotiation with the international creditors encouraged the outflow of deposits at high rates and led to the third recapitalization of the Greek banking institutions. Capital needs of €4.4 billion under the baseline scenario and of €14.4 billion under the adverse scenario were recognized (Mitrakos, 2016). The banks of the sample raised through capital increases €8 billion, thus they managed to cover the needs of the baseline scenario through private investors and to increase the average CAR from 14.35% in 2014 to 16.58% in 2015, which is, however, lower than the average CAR of the Euro area banking sector. HFSF contributed the amount of €5.4 billion to cover only the adverse scenario for two of the systemically important banks.

Table 5.6: Common Equity Tier 1 Ratio (%) and Tier 1 Ratio (%) of the selected banks (2002-2015)

Year/ Bank	Alpha Bank		Eurobank		NBG		Piraeus Bank	
	CET1 Ratio	Tier 1 Ratio	CET1 Ratio	Tier 1 Ratio	CET1 Ratio	Tier 1 Ratio	CET1 Ratio	Tier 1 Ratio
2002		6.90		n.a.		7.40		11.65
2003		10.40		n.a.		10.10		11.14
2004		10.10		8.80		11.80		10.30
2005		10.40		10.94		12.31		8.80
2006		10.20		8.46		12.40		7.40
2007		9.60		9.22		9.20		9.76
2008		8.00		8.00		10.00		8.00
2009		11.70		11.50		11.30		9.10
2010		11.90		10.60		13.10		8.40
2011		4.20		n.a.		-3.70		-6.10
		8.40*		9.50*		7.20*		7.40*
2012		8.90		10.20		n.a.		9.30
		12.80*		11.60*		8.47*		12.20*
2013	16.10	16.10	10.40	10.60	10.30	10.30	13.90	13.90
2014	14.30	14.30	16.20	16.20	13.50	13.50	12.40	12.40
2015	16.70*	16.70*	17.00*	17.00*	14.50*	14.50*	17.50*	17.50*

*includes HFSF's advance payment and/or capital raise

Source: Based on data from the Bankscope Database and Pillar III reports of the selected banks

Similar pattern with CAR is, as expected, observed in the evolution of Tier 1 ratio (see Table 5.6).

Since 2014, the capital adequacy levels of the banking institutions are well above the supervisory minimums imposed by Basel lll (see Appendix E) while the upward trend in CET1 during the two-year period 2014-2015 contributes to a stronger capital position of the selected banks, thus to an increased capability of expanding their lending activities.

5.1.4 Asset Quality

Table 5.7: Non-Performing Loans Ratio (%) of the selected banks (2006-2015)

Year/Bank	Alpha Bank	Eurobank	NBG	Piraeus Bank	Average
2006	5.08	3.47	5.35	5.03	4.73
2007	3.86	3.23	4.16	3.39	3.66
2008	4.52	3.89	4.31	3.56	4.07
2009	6.66	7.28	6.90	5.08	6.48
2010	10.44	10.45	10.48	7.58	9.74
2011	21.16	15.34	26.49	17.07	20.02
2012	26.62	22.97	31.58	21.45	25.66
2013	44.76	30.74	28.60	30.68	33.70
2014	44.84	38.59	26.38	40.51	37.58
2015	50.32	43.37	37.92	43.30	43.73
Average	21.83	17.93	18.22	17.77	

Source: Based on data from the Bankscope Database

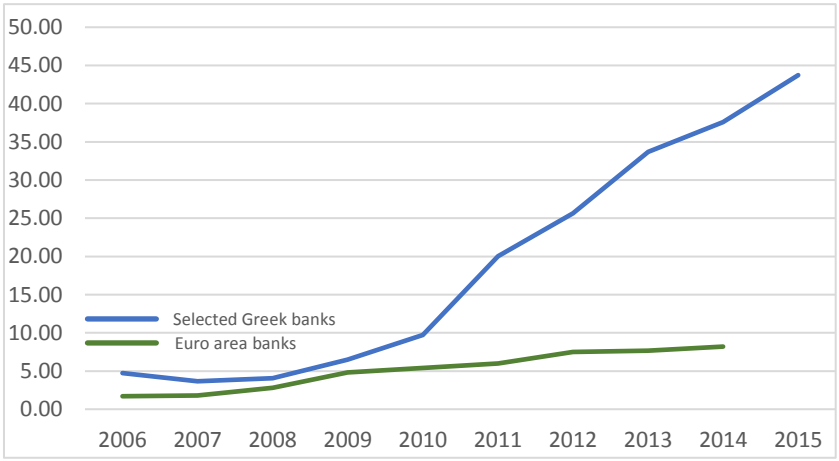

Figure 5.6: Non-Performing Loans Ratio (%)

Source: Based on data from the Bankscope Database and World DataBank

The quality of the loan portfolios of the Greek banking sector became progressively poorer since 2008 when the first signs of deterioration in the macroeconomic aggregates of Greece emerged. The households and the enterprises suffered a negative impact on their financial condition due to wage cuts, increased unemployment as well as increased tax liabilities which contributed to a significant reduction in their disposable income and, subsequently, to a weakening of their capacity to repay debt obligations. The demand for new loans sharply declined and hesitation of the credit institutions to issue new loans increased. Therefore, a sharp increase in the NPLs ratio occurred from

2008 to 2015 (see Figure 5.6) while NPLs increased across all loan categories. The NPLs ratio rose to the unprecedented level of almost 45% in 2015, on average (see Table 5.7), indicating management's constraint ability to identify, keep under systematic view and effectively control credit risks. The decrease in the rate of formation of new NPLs and the increase in the deleverage rate, during the two-year period 2014-2015, due to the decline in demand for financing and the write-offs of bank loans, were not enough so as this ominous situation to be arranged.

5.1.5 Liquidity

Table 5.8: Loans to Deposits Ratio (%) of the selected banks (2002-2015)

Year/Bank	Alpha Bank	Eurobank	NBG	Piraeus Bank	Average
2002	100.45	75.26	51.49	86.06	78.31
2003	107.74	82.39	52.00	92.38	83.63
2004	108.12	88.54	63.75	107.70	92.03
2005	126.39	93.72	68.12	117.08	101.33
2006	136.69	91.83	80.07	122.06	107.66
2007	121.37	96.31	90.36	137.26	111.32
2008	119.17	103.06	103.31	134.99	115.13
2009	119.77	102.50	105.00	125.36	113.16
2010	128.76	112.93	113.56	127.69	120.74
2011	152.64	136.90	120.07	148.24	139.46
2012	142.56	134.42	117.73	120.67	128.84
2013	118.90	107.76	107.00	114.90	112.14
2014	113.49	102.33	105.03	104.40	106.31
2015	145.42	126.47	105.74	129.88	126.88
Average	124.39	103.89	91.66	119.19	

Source: Based on data from the Bankscope Database

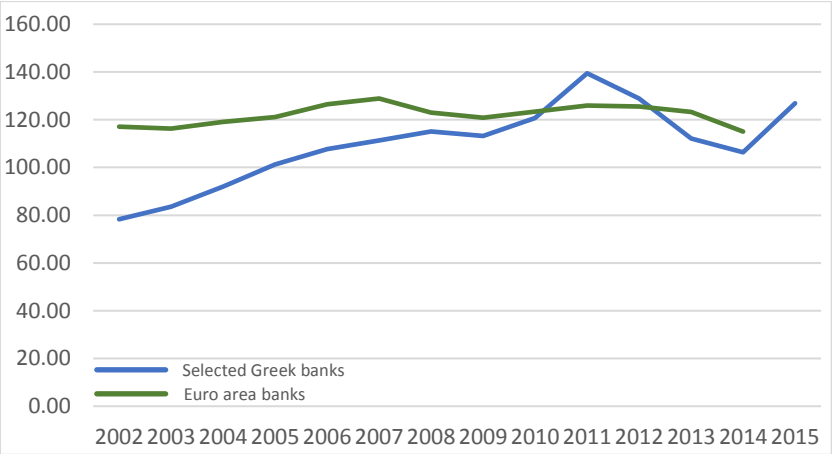

Figure 5.7: Loans to Deposits Ratio (%)

Source: Based on data from the Bankscope Database and World DataBank

The steady increase in LDR till 2008 (see Figure 5.7) is attributed to the strategic choice of the selected banks to employ deposits in order to develop growth strategies and highlights the requirement for external funds injection in order that growth as well as finance investment in the banking industry to be sustainable (Alexiou and Sofoklis, 2009) The ongoing fiscal crisis in Greece posed significant liquidity contractions in the Greek banking sector. The consecutive sovereign downgrades and the subsequent downgrades of the Greek banks prevented the access of the latter to the funding markets and forced them to recourse to the alternative of funding from the Eurosystem while deposit outflows further exacerbated liquidity levels. Finally, the increased uncertainty and the strengthening of the probability of exiting the Eurozone, which was intensified in the first half of 2015, led to a massive outflow of deposits and undermined confidence in the Greek banking system, aggravating rapidly the liquidity levels of the selected banks. It is worth mentioning that during the six-year period 2010-2015, the deposits amount reduced by €105 billion with respect to the entire Greek banking sector (BoG, 2016). It is noteworthy that the slight improvement in LDR recorded in 2012 is attributed to a sharp decline in outstanding loans due to households and enterprises' falling demand for new loans. This trend in outstanding loans continued during 2013 and 2014 while deposits increased due to an amelioration in economic sentiment, thus a further improvement recorded (128.84% in 2012, 112.14% in 2013 and 106.31% in 2014).

Finally, a thorough examination of the LDR values at bank-level indicates that NBG was consistently less leveraged, thereby more conservative than its competitors holding the minimum LDR values almost throughout the period under examination (see Table 5.8).

Overall, the Greek banking system continues to be loss-making due to significantly high stock of NPLs, due to lack of demand from households and enterprises for loans as well as due to deleveraging. Therefore, credit growth prospects and sustainable bank profitability are impeded. Additionally, due to the restrictive liquidity conditions, the capability of the banking institutions to offer new credit is, also, very limited. As a result, the ability of the banks to generate new capital through retained earnings and, consequently, to further increase their capital buffers is compounded. Finally, the capital requirements imposed by the Basel III are adhered by the selected banking institutions, however, their performance with respect to the Liquidity Coverage Ratio (LCR) is disappointing (see Appendix E).

5.2 Multiple Regression Analysis

As highlighted in paragraph 4.2.2, this study investigates two distinct time periods in order that the impact of the recent financial crisis on the Greek banking sector to be fully investigated. More specifically, the time period 2002-2008 constitutes the period before crisis and the time period 2009-2015 constitutes the period throughout crisis. Table 5.9 illustrates the empirical results of the computations executed and concerns the findings of the period 2002-2008 in the first column and the findings of the period 2009-2015 in the second column.

The dependent variable selected is Return on Average Assets (ROAA) while the independent variables selected are Cost to Income Ratio (CIR), Equity to Total Assets Ratio (EQTAR), Loan Loss Provisions to Gross Loans Ratio (LLPGLR), Loans to Deposits ratio (LDR), GDP growth (GDPGROWTH) and inflation (INFL).

Table 5.9: Summary of the multiple regression analyses

	Before crisis period 2002-2008[a]		Throughout crisis period 2009-2015[b]	
	Coefficient	p-value	Coefficient	p-value
CIR	-0.002	0.115	0.009	0.606
EQTAR	0.029	0.017**	0.563	0.000***
LLPGLR	-0.033	0.150	-0.179	0.000***
LDR	0.002	0.025**	-0.017	0.198
GDPGROWTH	0.002	0.549	-0.030	0.155
INFL	-0.005	0.858	-0.067	0.513
R^2	0.857		0.772	
Adjusted R^2	0.847		0.756	
F-statistic	84.518	0.000***	47.131	0.000***
Durbin-Watson	1.777		1.851	

[a] : No. of observations = 108
[b] : No. of observations = 106
The significance levels of 1%, 5% and 10% are indicated with ***, **, * respectively
Dependent Variable: ROAA
Predictors: (Constant), CIR, EQTAR, LLPGLR, LDR, GDPGROWTH, INFL

Interpreting the above results, the number of observations in each regression equation is 108 and 106 respectively after the removal of 4 and 6 observations respectively, which were highly influential on the regression equations as indicated through the influence analysis. Next, the assumptions of linearity and homoscedasticity are met as assessed by plotting the residuals on the vertical axis against the corresponding X_i values of each independent variable on the horizontal axis (see Appendix G). After successfully removing autocorrelation from both regression equations with the first differences procedure, the Durbin-Watson statistic is 1.777 and 1.851 respectively (see Table 5.9), thus there is no evidence of autocorrelation. Collinearity issues were examined through the values of VIFs which do not exceed the conservative criterion of 5. The assumption of normality is met as assessed by the Q-Q Plot of residuals. Regarding the first equation, the coefficient of multiple determination (R^2) is 85.7% with an Adjusted R^2 of 84.7%, thus 84.7% of the variation in ROAA is explained by the model – adjusted for the number of independent variables and sample size. Also, there is significant relationship between ROAA and the entire set of independent variables because p-value=0.000<0.05. Similarly, for the second equation, R^2 is 77.2% with an Adjusted R^2 of 75.6%, a

satisfactory size effect. Finally, there is significant relationship between ROAA and the entire set of the independent variables because p-value=0.000<0.05.

The first independent variable, CIR, is found, as expected, to be related in a negative, yet insignificant manner with bank profitability during the pre-crisis period. However, amid the crisis, this relationship turns to be positive while the level of significance remains the same. This positive relationship is not consistent with the assumptions of this study because higher CIR implies decreased efficiency, thus decreased (and not increased) profitability. Per Goddard et al. (2013), a possible explanation could be that, during times of deteriorating efficiency levels, the banking institutions offer their customers lower deposit rates or/and higher interest rates, thus a rise in profitability is possible to be materialized.

Concerning the results related to capital adequacy, EQTAR is consistently related to bank performance in a significant and positive manner. This finding, concerning both the period before and the period throughout the recent financial crisis, complies with the relevant studies mentioned in the Literature Review section and suggests that banks with higher equity levels are expected to be relatively more profitable. It is noteworthy that the respective regression coefficient was remarkably increased from 0.029 during 2002-2008 to 0.563 during 2009-2015, indicating the vital significance of this factor for the banks' efforts to achieve sustainable profitability.

Unsurprisingly, the effect of LLPGLR is negative for both of the time periods, yet statistically significant only for the time amid the crisis. This is an anticipated and reasonable finding because loan loss provisions constitute the cumulative stock of loan loss provisions built relative to the amount of new loan loss provisions added on a yearly basis. Additionally, due to the high levels of credit risk during the seven-year period 2009-2015, the loan loss provisions exceeded the one third of operating income affecting profitability in a negative way. Also, from 2009 onwards the banking institutions, following the suggestions of BoG, increased their loan loss provisions so as to cope with anticipated increased losses with respect to their loan portfolios (BoG, 2010; BoG, 2012). The increase in the negative impact of this indicator – from -0.033 to -0.179 – signifies the ultimate importance for banks to systemically design lines of actions so as to address credit risk.

With respect to the period 2002-2008, the relationship between liquidity and profitability is significantly negative – because as LDR increases, liquidity is predicted to decrease – in conformity with Alexiou and Sofoklis (2009) who prove a significantly negative relation between bank profitability and liquidity with respect to the six most significant Greek commercial banks during 2000-2007. Given an increasing trend in LDR, thus a decreasing trend in liquidity, during the period 2002-2008, a possible explanation of this finding could be that the bank managers succeeded in increasing profitability during the respective period by withdrawing those liquid assets which were tied with lower rates of return. However, the relationship between liquidity and profitability is positive yet not significant when the period 2009-2015 is examined, therefore the findings of Eichengreen and Gibson (2001), who reveal a significant and positive association between liquidity and profitability, are partly supported. Overall, the trade-off which is supposed between profitability and liquidity is confirmed.

GDPGROWTH is positively and negatively correlated to ROAA before and throughout the recent crisis respectively, while this relationship is insignificant with respect to the whole period. The finding related to the pre-crisis period is as expected and consistent with Kosmidou (2008). However, amid the crisis, the finding is not as expected, yet it is in accordance with Staikouras and Wood (2004). Given the increasing trend in GDP during the four-year period 2011-2014, a possible explanation could be the prevalence of initiatives related to more competitive interest and profit margins by the selected banks in their effort to confront the decreased demand for banking services.

Finally, INFL has consistently a negative impact on bank profitability and the same, low level of significance concerning both time periods under review. This result contradicts the study of Athanasoglou et al. (2008). However, it is in accordance with the study of Kosmidou (2008). According to Athanasoglou et al. (2008), a negative relationship between bank profitability and inflation could be attributed to the failure of bank management to predict future levels of inflation, thus to adjust interest rates, or to sound inflationary assumptions by the customers – implying that asymmetric information could lead to above normal profits.

6. Conclusion and Policy Recommendations

This paper encompasses an empirical evaluation of Greek banking sector performance over the period 2002-2015. Having presented the evolution of the macroeconomic aggregates of Greece during the respective period and having highlighted the severe and complex environment within Greek banks operate, the trajectory over the fourteen-year period of carefully selected financial ratios related to bank performance is presented. The implementation of PSI turned out to have devastating consequences for the Greek banking system which is still loss-making, thereby credit growth perspective is eliminated and sustainable bank profitability is hindered. The ominous situation is further aggravated by the major credit and liquidity risks that the selected banking institutions face. Informing the existing academic literature, the multiple regression analysis proves that the external determinants do not constitute significant influencing bank profitability determinants. Among the internal determinants of bank profitability, EQTAR and LDR are proved to have significant contribution to bank profitability during the pre-crisis period. However, only EQTAR retain this attribute amid the crisis while LLPGLR emerges as a new significant bank profitability determinant. Therefore, high levels of ROAA are found to be tightly correlated with well-capitalized banks which manage to mitigate effectively credit and liquidity risk. This conclusion is in accordance with Athanasoglou et al. (2008) who argue that poor asset quality and liquidity constraints are the two major contributing factors to bank failures. Thus, the need for establishment of risk management procedures is inherent in the banking business nature.

Incorporating managerial implications, this paper provides recommendations so as the banking institutions to hedge credit risk. Besides, Nouy (2017), Chair of the Supervisory Board of ECB, sets credit risk mitigation as one of the main priorities of European banking supervision. Credit risk could be mitigated through a more active policy towards timely and effective NPLs management. This objective calls for measures which concentrate on long-term arrangements, facilitate provisioning, accelerate distressed loans recognition, offer a more effective restructuring framework for businesses which are characterized as viable and involve tight and rigorous supervision in the evaluation of collaterals. Adherence to supervisory guidelines and implementation of stress test

exercises and asset quality reviews could speed up balance sheet recognition of distressed loans. Additionally, in order to tackle the NPLs issue through prudent collateral evaluation, the banking institutions should adopt methods such as regular reappraisal of collateral needs, collateral additions – because of fluctuations in asset prices – as well as restrictions on the type of collaterals used. However, the banking institutions should never neglect the fundamental principle which states that, within the framework of loans issue, the priority should be first in the credit granting criteria, the purpose of the credit as well as the repayment source and, secondly, in the collateral value.

Also, the banking institutions should establish independent corporate units dedicated in the management of NPLs and should staff them with competent executives, based on knowledge, experience and expertise, who will be able to establish documented strategies for effectively managing these exposures. Equipping these units with appropriate IT systems as well as with innovative management information systems will facilitate their operation and will bring immediate results.

Alternatively, another strategy for the banking institutions so as to moderate investors' and public's reservations regarding their balance sheets and avoid the risk that the repeated recapitalisation rounds involve is to extract distressed loans from their balance sheets and convert them into tradable securities through debt securitization. Another alternative is the use of synthetic securitizations through credit derivatives which are called total return swaps and which involve a willing swap counterparty and a viable underlying asset. This option offers the banks the opportunity to manage market, credit and liquidity risk in a synthetic way through disentanglement from exposures in assets without the involvement of asset divestiture or securitization and without the ownership of the original assets to pass to the security issuer or to the investor. However, in case the above alternative is adopted, rigorous supervision is required (Culp, 2001).

The business objective, to hedge liquidity risks, calls for providing strong incentives for the return of deposits, streamlining the liquidity modeling, planning so as the latter to simulate the leading practices of the European banking industry and designing appropriate liquidity stress tests. Also, continuing to dispose non-core assets outside of

Greece and promoting investments in high-quality and low-risk liquid assets could increase the value of the banking institutions' liquid assets.

The banking institutions could increase profit margins on other business lines, such as asset management, or continue not to pay out dividends in a way to increase retained earnings, thus to increase risk-adjusted capital ratios. Towards the same objective, the banking institutions could choose to continue the sales of assets so as to pay down debt or to reduce RWA by replacing riskier and higher-weighted loans with safer ones (Cohen, 2013).

Furthermore, technology and innovation should be fully utilized so as the banking institutions to monitor risk measures in real time and to distribute timely the necessary risk information. The implementation of sophisticated Enterprise Risk Management programs which include tools for the control of operational risk and for the integration of the practices followed for risk, capital and balance sheet management could deepen operational restructuring (Crouhy et al., 2006). Also, enhanced transparency and public disclosure of operational risk management information will streamline industry practices through market discipline and will revive confidence in the banking institutions' operations.

A final key recommendation of this study is that a particular development in the economic environment should not be investigated independently of others. Therefore, the structural changes that the economic environment is subject to and the emergence of new risks should be jointly examined within the context of a robust bank performance analysis.

Turning to the limitations of this study, up until the time this study was completed, there were no available annual data for the year 2016, thus it was not possible the latter to be included in the analysis. Also, the impact of capital controls, imposed in July 2016, on bank performance constitutes an intriguing issue, however there are not yet sufficient available data so as the effect of this development to be fully investigated.

Finally, performance analysis calls for continuous improvements as well as innovation. Therefore, future research could be extended towards the comparison between domestic and comparable foreign credit institutions before and throughout the recent

financial crisis and towards the investigation of the differences in their profitability determinants.

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Appendices

A. Results of the stress tests by EBA and ECB and of the capital needs assessment by BoG of the selected banks

(million euro)

Year/ Bank	Alpha Bank		Eurobank		NBG		Piraeus Bank	
	Baseline scenario	Adverse scenario	Baseline scenario	Adverse scenario	Baseline scenario	Adverse scenario	Baseline scenario	Adverse scenario
2010	**EU-wide stress test by EBA** Baseline scenario to 6% Tier 1 Ratio Adverse scenario to 6% Tier 1 Ratio							
	> 6%	8.22%	> 6%	8.17%	> 6%	7.40%	> 6%	6.00%
2011	**EU-wide stress test by EBA** Baseline scenario to 5% Core Tier 1 Ratio Adverse scenario to 5% Core Tier 1 Ratio							
	10.00%	7.40%	8.30%	4.90%	13.60%	7.70%	9.10%	5.30%
				Capital shortfall of 58				
	10.00%*	8.20%*	11.40%*	7.60%*	15.70%*	9.70%*	10.40%*	6.30%*
2012	**Capital Needs Assessment by BoG** Baseline scenario to 9% (for 2012) and to 10% (for 2013-2014) Core Tier 1 Ratio Adverse scenario to 7% Core Tier 1 Ratio							
	Capital shortfall of 4,571		Capital shortfall of 5,839		Capital shortfall of 9,756		Capital shortfall of 7,335	
	Total capital shortfall = 27,501							
2013	**Stress test by BoG** Baseline scenario to 8% Core Tier 1 Ratio Adverse scenario to 5.5% Core Tier 1 Ratio							
	Capital shortfall of 262	Capital shortfall of 560	Capital shortfall of 2,945	Capital shortfall of 4,980	Capital shortfall of 2,183	Capital shortfall of 2,502	Capital shortfall of 425	Capital shortfall of 757
	Total capital shortfall (baseline scenario) = 5,815 Total capital shortfall (adverse scenario) = 8,799							
2014	**EU-wide stress test by EBA** Baseline scenario to 8.0% Common Equity Tier 1 Ratio Adverse scenario to 5.5% Common Equity Tier 1 Ratio							
	13.80%	8.10%	2.0%	-6.40%	5.70%	-0.40%	9.0%	4.40%
			Capital shortfall of 2,282	Capital shortfall of 4,628	Capital shortfall of 1,278	Capital shortfall of 3,433		Capital shortfall of 660
	Total capital shortfall (baseline scenario) = 3,560 Total capital shortfall (adverse scenario) = 8,721							

2015	**Stress test by ECB** Baseline scenario to 9.5% Common Equity Tier 1 Ratio Adverse scenario to 8.0% Common Equity Tier 1 Ratio							
	8.98%	2.10%	8.59%	1.30%	6.79%	-0.22%	5.18%	-2.35%
	Capital shortfall of 263	Capital shortfall of 2,744	Capital shortfall of 339	Capital shortfall of 2,122	Capital shortfall of 1,576	Capital shortfall of 4,602	Capital shortfall of 2,213	Capital shortfall of 4,933
	Total capital shortfall (baseline scenario) = 4,391 Total capital shortfall (adverse scenario) = 14,401							

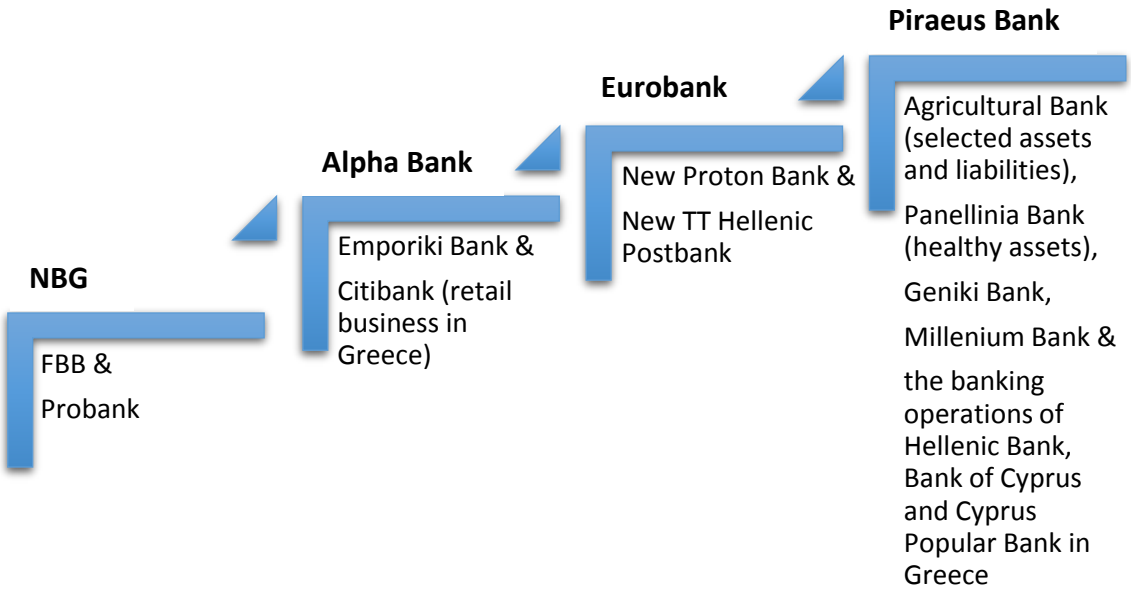
Source: Based on data from the European Central Bank, European Banking Authority and Bank of Greece

B. HFSF's participation (%) in the systemic banks (2013-2015)

Year/Bank	Alpha Bank	Eurobank	NBG	Piraeus Bank	Average
2013	81.70	95.20	84.40	81.00	85.58
2014	66.24	35.41	57.24	66.93	56.46
2015	11.01	2.38	40.39	26.42	20.05

Source: Based on data from the Hellenic Financial Stability Fund

C. The wave of acquisitions among the Greek banks after the implementation of the PSI programme



Source: Based on data from the banks' web sites

D. Aggregated data on the Greek banking sector international activity

	Subsidiaries	Branches	Personnel
2002	22	372	7,547
2003	27	693	13,039
2004	27	681	13,683
2005	30	1,098	18,219
2006	33	2,005	30,829
2007	32	2,886	40,763
2008	34	3,553	48.691
2009	34	3,430	48,111
2010	33	3,389	47,395
2011	33	3,108	44,648
2012	29	2,704	40,141
2013	29	2,629	42,423
2014	29	2,498	38,234
2015	27	2,276	35,523

Source: Based on data from the Hellenic Bank Association

E. 1) Basel requirements

	Basel I	Basel II	Basel III		
Capital framework					
Minimum Total Capital (% of RWA)	8.0	8.0			8.0
			2013	**2014**	**2015 onwards**
Minimum CET1 Capital (% of RWA)	n.a.	2.0	3.5	4.0	4.5
Minimum Tier 1 Capital (% of RWA)	4.0	4.0	4.5	5.5	6.0
Capital Conservation Buffer (% of RWA)	n.a.[1]	n.a.			2.5[2]
Countercyclical Buffer (% of RWA)	n.a.	n.a.			0-2.5[3]
Leverage Ratio[4]	n.a.	n.a.			3%[5]
Liquidity framework					
Liquidity Coverage Ratio (LCR)[6]	n.a.	n.a.			100%[7]
Net Stable Funding Ratio (NSFR)[8]	n.a.	n.a.			100%[9]

1: Not applicable

2: Minimum standard (0.625%) introduced on January 1, 2016 (increase by 0.625 percentage points each year reaching 2.5% on January 1, 2019)

3: Effective as of 2019

4: Ratio of Tier 1 Capital to total assets

5: Minimum standard. Disclosure began on January 1, 2015

6: Ratio of liquid assets up to 1 month to deposits on demand within 1 month.

7: Minimum standard (60%) introduced on January 1, 2015 (increase by 10 percentage points each year reaching 100% on January 1, 2019)

8: Ratio of available amount of stable funding to required amount of stable funding.

9: Minimum standard. Effective as of January 1, 2018

Source: Based on data from the Bank of International Settlements

2) Leverage Ratio (%) and Liquidity Coverage Ratio (%) of the selected banks (2015)

Year 2015				
Ratio/Bank	**Alpha Bank**	**Eurobank**	**NBG**	**Piraeus Bank**
Leverage Ratio	12.30	9.07	8.21	10.80
LCR	37.60	22.70	53.86	68.44

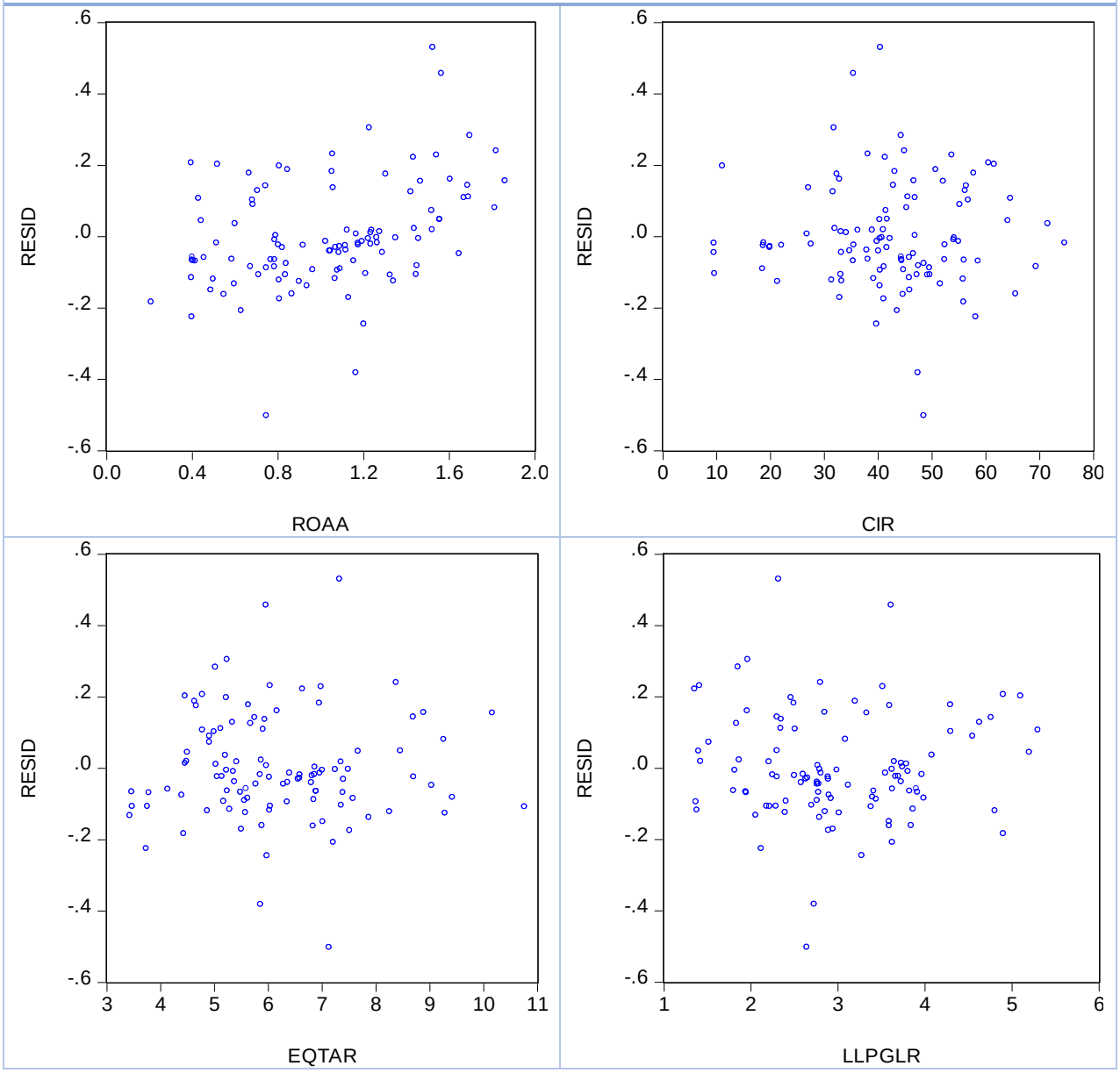
Source: Based on data from the annual financial reports and Pillar lll reports of the selected banks

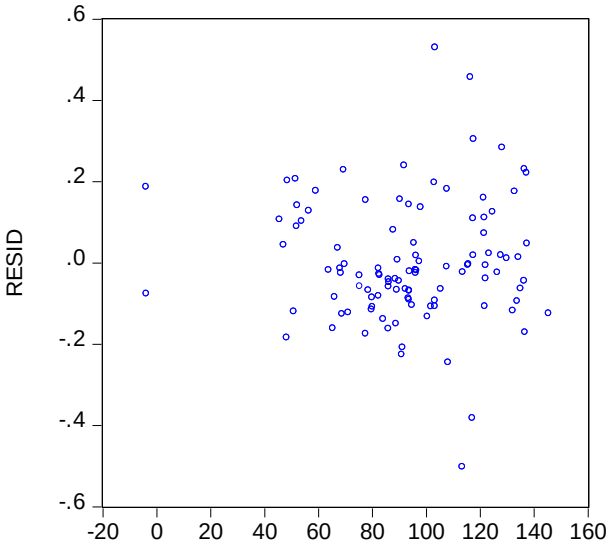
F. Variables Description

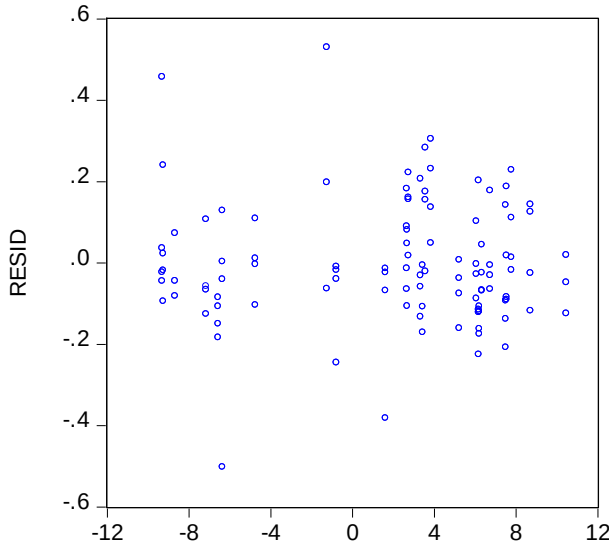
Variables	Description	Expected sign
ROAA	Profit (loss) after tax/Average of total assets	
CIR	Operating expenses/Operating revenues	**-**
EQTAR	Total equity/Total assets	**+**
LLPGLR	Loan Loss Provisions/Gross loans	**-**
LDR	Loans/Deposits	**?**
GDPGROWTH	The annual percent change of GDP	**+**
INFL	The annual inflation rate	**?**

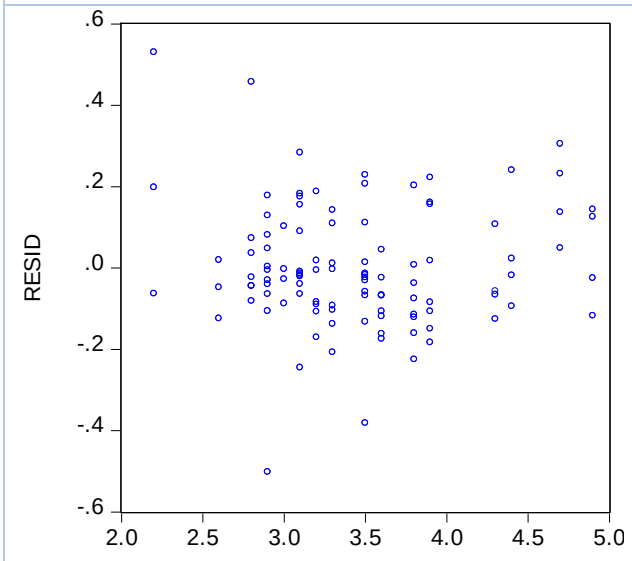
G. Extra results of the multiple regression analyses

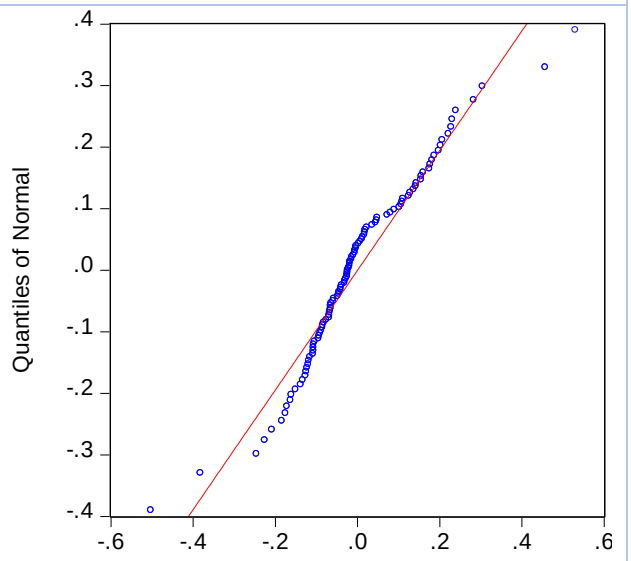
Before crisis period 2002-2008





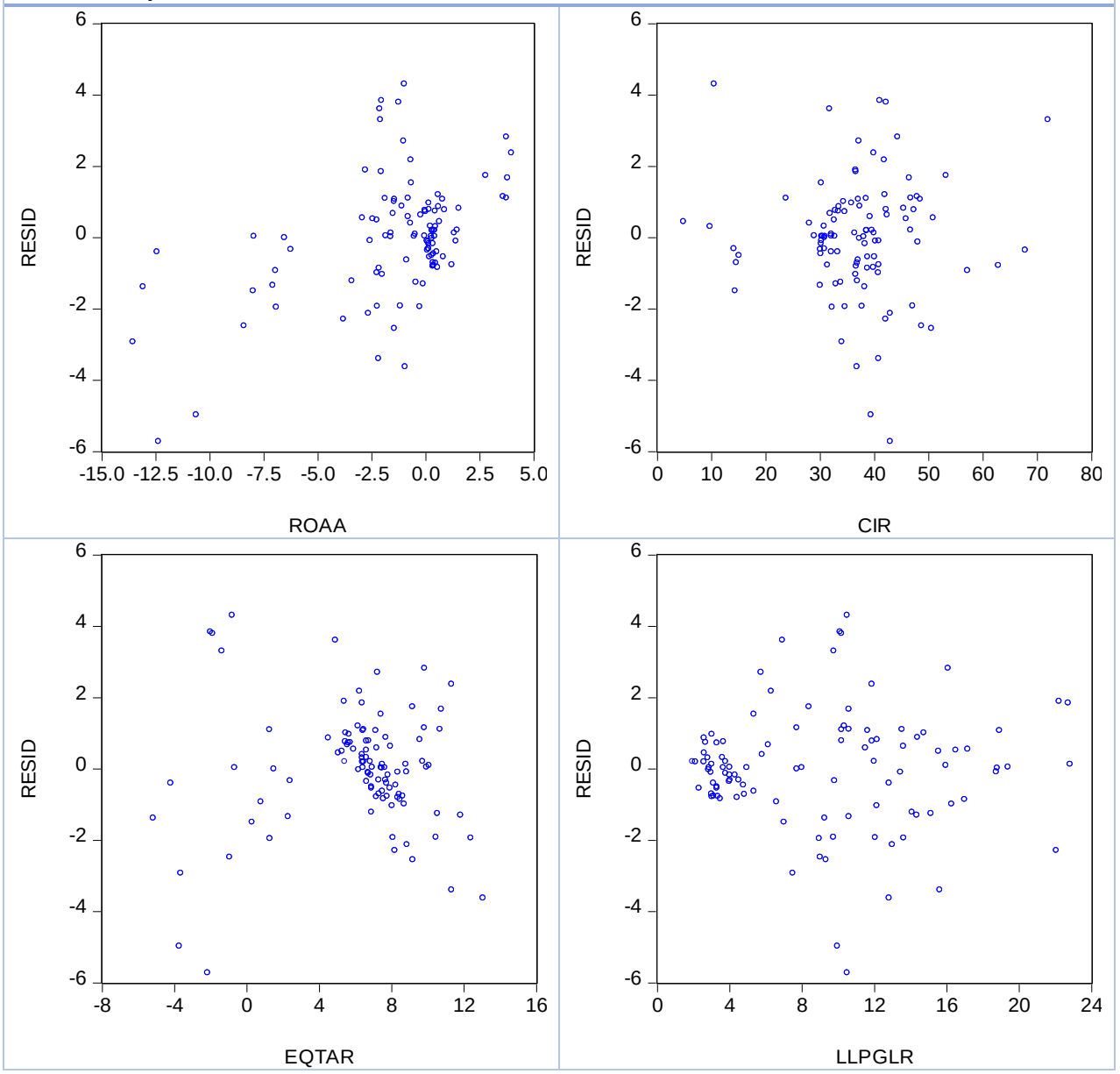


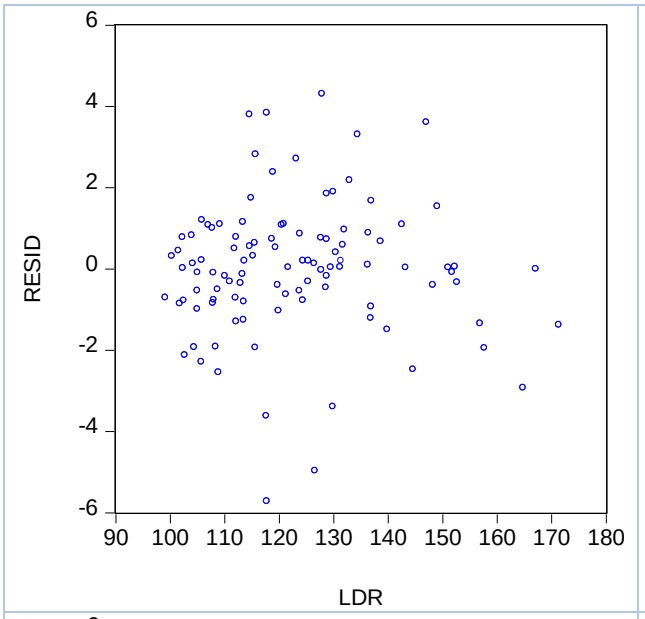


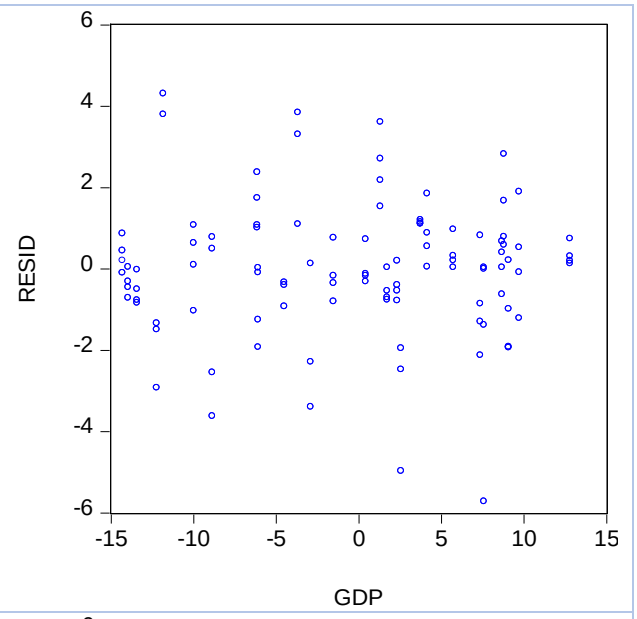


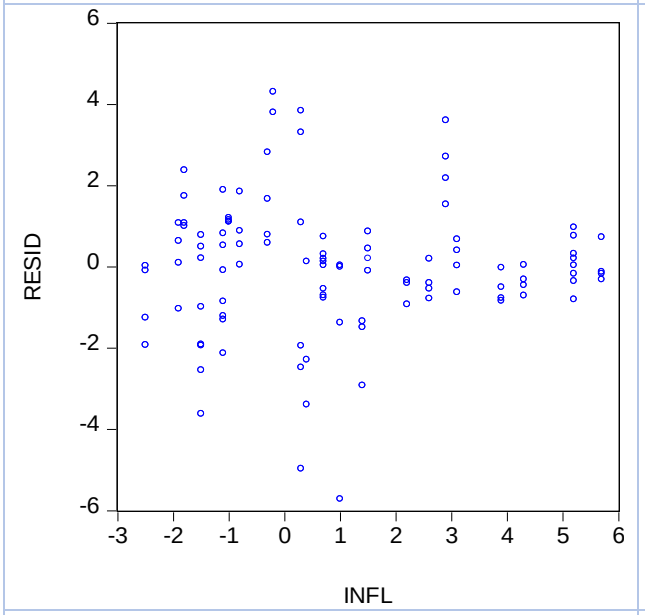
Variable	VIF
CIR	1.424815
EQTAR	1.371658
LLPGLR	1.967057
LDR	1.869446
GDP	1.015516
INFL	1.083250

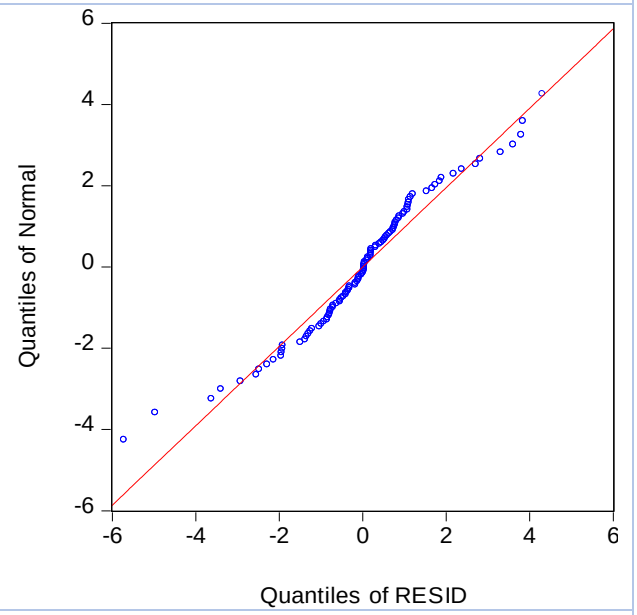
After crisis period 2009-20015











Variable	VIF
CIR	1.078587
EQTAR	1.496341
LLPGLR	2.190266
LDR	1.743741
GDP	1.069574
INFL	2.185930